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ELECTRICAL EQUIPMENT OF THE MOST MODERN THEATER.

It is but natural to expect that in a monumental edifice of national importance, reared for the specific purpose of fostering dramatic art and erected without stint, the electrical equipment would measure up to the standards set for the rest of the structure. The equipment of the New Theater, of New York City, described elsewhere in this issue, does not fall short of this expectation, for it represents the highest achievement in the electrical art as applied thus far to the stage. Such a distinction could not have been attained without many departures from beaten paths, and the secret of the success accomplished lies in the adoption of distant control. It may not matter much to the average audience how certain lighting effects are produced, and the more gradual and natural the transition the less likely it is to arouse comment; yet to bring about such refinements of light gradation requires nicety of equipment, unity of control and various other attributes which mean much and cost more. It is just in such details that the equipment of the New Theater excels. The switchboard operator, moreover, is given a new point of observation and is thus better enabled to employ the means at his command to the best advantage; for from his station in front of the footlights he controls the lighting of the stage and auditorium, and may supplement the effect of one by that of the other or may subordinate one to the other.

Heretofore the dimmers and switches for lighting stages and the body of the theater proper have generally been manually operated and have occupied much space behind the curtain. A distinctly noticeable feature of the New Theater is the absence of any control system on or next to the stage. There are also several radical departures from ordinary stage practice in the arrangement and make-up of the equipment. Instead of the standard border troughs, foot bridges are suspended back of the drops and under these the border lamps are placed. When concentrated light is desired on any portion of the stage, the spot lamps are placed on the bridges and not in the wings, according to the usual practice, and better results are obtained. The footlights, border and strip lamps are not only distinctive, but the method of controlling them is unique. The control board is not wider than a man can reach with extended arms and any and all of the dimmer switches can be set at any desired shade and the effect produced immediately or brought up gradually at any speed ranging from 2 seconds to 16 minutes. One need not be a stage manager to realize the immense possibilities for charming sunrise, sunset and other scenic effects which such control affords. By double and triple circuiting the fixtures in the auditorium, the operator can grade the illumination in the house to suit the character of the play and also drive patrons to their seats by switching off the greater part of the lamps in the corridors and circulation as a signal that the performance is about to begin. There is much that is commendable in the employment of the telephone in the wings, flies and gal-

leries of the stage as a means for communication between the stage director, scene shifters and other stage operators, and in the means employed for signaling these men, as well as in the arrangement of stage pockets and connectors. The employment of acousticons in the body of the theater is a refinement which should appeal to persons hard of hearing and will offset the baneful effect produced by actors given to soliloquizing.

PARALLEL OPERATION OF ALTERNATORS.

Much interesting information concerning the limits in speed variation which may be allowed with alternators in parallel is contained in an article by Mr. Warren H. Miller which appears in this issue. From the data obtained by the author he has been led to conclude that when an engine runs steadily enough to show less than 1 part in 250 speed variation, the generator which it drives can be parallel with a similarly driven alternator without hunting. The value stated seems to have been based on observations made largely on 60-cycle alternators, and if applicable to such machines could be much exceeded in the case of 25-cycle alternators. Moreover, the hunting of generators is affected equally as much by the extent of the swing as by the velocity of swinging. That is to say, not only must the percentage variation in speed be taken into account, but attention must also be paid to the frequency of the swinging which determines the maximum instantaneous angular change in space of two alternators in parallel. A swing of six electrical space degrees, for example, will permit about 10.5 per cent of the short-circuit current to be produced locally in the armature windings; it is the excess of this current which one should seek to avoid. The author's conclusions relative to the effectiveness of dampers of the squirrel-cage type in minimizing the hunting accord with the facts, but his arguments concerning the similarity to the induction motor must be somewhat modified to cover the conditions actually existing in an alternator. In an induction motor the squirrel-cage rotor is affected by a true revolving field of constant value. In an alternator there is a negatively revolving magneto motive force of constant value, but the field produced thereby is not of constant strength, being great in line with the field poles and may be considered as negligible in electrical space quadrature therewith. Very little torque would be produced in a squirrel-cage rotor subjected to the slip of 3 per cent, assumed by the author, if the only field cut by it were that existing between the poles on a gas-engine-driven alternator.

If the reactance were uniform around the air-gap, the practically constant revolving armature magnetomotive force would produce an equally nearly constant revolving magnetism, and a squirrel-cage damper subjected to variations in the relative space positions of it and the magnetism would indeed exert a torque similar to that of a squirrel-cage rotor of an induction motor. However, the field produced by the armature magnetism is confined largely to that part of the circumference covered by the pole faces, and hence by far the most effective portion of the squirrel-cage damper is that in the pole faces. The remaining portion is only slightly active in producing torque directly, but its presence is not detrimental because the continuous end rings serve as additional paths for currents produced by the electromotive forces in the active conductors embedded in, or surrounding, the pole faces. Although the effectiveness of the squirrel-cage damper cannot be questioned, the author's explanation of its action can hardly be considered conclusive, because when that part of the damper which should be most effective to agree with his discussion is entirely omitted, the damper continues to operate with only a slight decrease in its steadying effect.

THE SECULAR SOFTENING OF HARD STEEL.

The December number of the *Physical Review* contains an article by Prof. Carl Barus on the softening which hard-steel wires undergo by the action of time, when left severely alone. The lower the temperature, the longer it takes to remove the hardness from a piece of hard steel. We all know that at a fairly high temperature, such as that of melting lead, the temper will be rapidly withdrawn, but it is not generally known that ordinary room temperatures will remove the temper in the course of centuries. Steel has the remarkable property of increasing in resistivity as it is hardened. Very hard steel may have a resistivity of 46 microhm-centimeters, or 46 microhms in a cubic centimeter, whereas soft steel may have only 15 microhm-centimeters. In fact, the degree of hardness of steel admits of being readily measured, compared and specified in terms of electric resistivity. The law of softening, in terms of resistivity, is that the electric conductivity at any time is equal to the final soft-steel conductivity less an exponential value of the time multiplied by the difference between the initial and final conductivities. That is, the conductivity rises to the full value along an exponential curve. The rise is rapid at first, but is progressively slower. If the conductivity rises by 50 per cent of the full ultimate change within a century, it will rise 50 per cent of the remainder in the next century, again 50 per cent of the next remainder in the next century, and so on. The paper discusses the various formulas that might be considered as representing the observations. Fortunately, it is not necessary to wait for a century or two to make comparisons and deductions.

The process can be hastened to any extent desired by raising the temperature at which the steel is preserved. At the temperature of boiling water, events progress very cheerfully, so that the behavior at higher temperatures than ordinary room temperatures can be predicted after a few observations some months apart. The conclusion reached by the paper is that if by any miracle the tools in Joseph's carpenter shop, at the beginning of the Christian era, had been glass-hard steel, they would now be so soft as to need most decided re-tempering.

LUMINOUS EFFICIENCIES.

A paper by Professor Hutchins, noted in the Digest, gives a method of obtaining the luminous efficiency of sources which seems rather well suited to easy approximations. The efficiency of an illuminant with respect to the total energy radiated by it is a quantity which has been many times measured, but by methods usually requiring somewhat intricate apparatus and rather exasperating corrections. The quantity to be determined is a ratio of the luminous energy to the total. Now, the total is readily enough obtained by letting the light under investigation be concentrated upon a thermopile or bolometer. The

next step in the problem is to segregate the luminous from the non-luminous energy and measure one of them. Here is where the difficulty ordinarily comes in. The dividing line between one portion and the other is generally taken at the extreme red of the visible spectrum, about wave length 7600. To measure piecemeal the whole range of the spectrum so as to compare its two sections is a decidedly troublesome job, and particularly difficult if the luminants are not steady owing to the time taken. The segregation of the infra-red and the visible portions by means of absorbing screens is likewise troublesome as involving a fairly precise knowledge of the absorption of the screens, which can, of course, be obtained once for all, but only with considerable labor.

Professor Hutchins' method is the simplest one which we have yet seen, and, while not avoiding entirely the necessity of corrections, is on the whole less subject to them than other methods. On the face of the facts it would seem to be reasonably accurate although probably less precise than the strictly photometric method when the latter can be successfully applied. It depends upon four measurements made by means of the thermopile or bolometer: First, with the bare illuminant giving the total energy visible and invisible; second, measurement through the cell containing water. This lets through practically all the light barring that which is absorbed by the glass, which can be readily determined. This cell, however, cuts off a very large part of infra-red radiation. The next step involves a determination of this infra-red portion, which is accomplished by two further measurements, one of which is taken through a prism from which the infra-red portion of the spectrum is concentrated upon the thermopile. This first measurement gives the energy in the short stretch of infra-red transmitted by the water. The second is taken through a solution of potassium permanganate which cuts off all the visible portion of the spectrum, but lets through some infra-red within precisely the same range as that transmitted by the water. The deflection is also taken through the permanganate cell without the intervening prism.

Now, the comparison through the prism gives the ratio between the infra-red energy transmitted by the water and that transmitted by the permanganate solution, eliminating the visible portion of the spectra. But since the ratio of the energy transmitted by the permanganate solution to the total energy has already been determined, this ratio gives means of computing the effect of the infra-red transmission by the water cell, and hence the ratio between the total energy and the visible portion in the original light. The computation is an extremely simple one. The obvious difficulty in the method is to be sure that the solution intended to exclude the visible light transmits only such energy as is also transmitted by the plain water. Professor Hutchins finds that potassium permanganate meets this requirement, the two transmission curves being sufficiently similar to introduce no sensible error. Testing out this method on an acetylene flame, Professor Hutchins finds an efficiency of practically 3 per cent, which corresponds very closely to results obtained by other and more intricate methods. The method seems indirect, but this very indirection renders it possible to eliminate some very important corrections, which is sufficient justification for the method.

THE TELEPHONES OF THE WORLD.

According to reports in the daily press, the British Chancellor of the Exchequer has recently proclaimed the United States as a horrible example of the effects of tariff protection, "where customs officers line the shores like cherubim," but where, in New York State, there was 30 per cent of unemployment, last May, as against 7 per cent in England. We may take comfort in turning from the continual cry of the customs' cherubim to the constant answer, in the still small voice, of the telephone seraphim, because a recent article in *Elektrotechnik und Maschinebau*, abstracted in the Digest, declares the United States to be *facile princeps* in the use and development of the telephone. It appears from the statistics presented in the abovementioned article that there were in January, 1909, more than twice as many telephones in the United States as in all the world besides. The proportional preponderance is not, however, being maintained, for, according to the figures, there were in 1900, or nine years previously, three times as many telephones in the United States as in all other countries combined. In regard to the recorded use of telephones, there is little relative difference for the figures allotted to our own country and to the rest of the world. Each telephone was guilty of 1730 annual conversations in the United States, and of 1945 annual conversations in all other countries together. Taking the whole world, there would be about 1800 average conversations of record per telephone, or six per working day. The figures for Asia are, however, 3130 per telephone per annum. Whether that means that in Asia people are more talkative is a matter we leave to psychologists, philosophers or statisticians to say.

When we consider the use of telephones in individual cities of the world, the United States does not stand out so preeminently. The record for multiplicity of telephones among American cities in 1908 was in San Francisco, with 1 connected telephone to 9.9 inhabitants. New York, Chicago, Philadelphia and Boston were all close together, near 1 in 13.5. But the world's palm, in this respect, is held by Stockholm, Sweden, which claims 1 connected telephone to 6.5 inhabitants. This must mean a telephone in nearly every house. The causes for rapid telephonic development in any community are manifestly numerous and complex. Enterprising business management, combined with effective technical construction and maintenance, are essential features in the building up of telephonic service, until the public become accustomed to the need of the apparatus and insist upon its extension. If the business in the early days had been badly financed, or poorly managed, no technical skill in the construction and maintenance of the apparatus could have saved the situation. On the other hand, good business management is powerless if the technique of construction, maintenance and service operation is imperfect. No business man will attempt to use a telephone if he looks upon the call of his desired correspondent, through the telephone exchange, in the light of an experiment. But as soon as he regards the connection with the desired office as a virtual certainty the telephone habit becomes rapidly irresistible. The difficulty at the present moment is not to get into communication with the right office, but to secure the attention of the right man in the right office. The right man is as a usual thing busy talking to someone else.

ELECTRICAL GROWTH IN 1909.

There certainly was a healthy growth in the various electrical industries during 1909, but it may be questioned whether in some directions the vast figures of 1906-07 have yet been exceeded. A careful survey of the field would indicate that a probably larger total for 1909 than 1908 is due to greater miscellaneity of production and service; and this in itself must be regarded as a notable condition of health. It is obvious to everyone, for example, that a great many more electric automobiles have been built; that wireless telegraphy is in more widespread use; that electric heating and cooking devices are in greater variety and popularity; that electric motors have been applied to novel purposes; that new lamps have come in to broaden the domain of electric illumination. In turn, this all means larger consumption of wire, supplies, electrical energy; and thus the industry builds upon itself by a kind of self-induction, which in prosperous years results in amazing totals, and in average years maintains a higher rate of growth than is common to the industry of the country as a whole.

Along the lines of such a study as this we have been accustomed to sum up in a general estimate at this season the statistics of the preceding year, and doing this conservatively have found our figures afterward to be very near the facts. It is when such years of terrific expansion as 1906 come that it is difficult to get close to the facts. It is quite likely we may have another notable advance in 1910, but there was nothing spectacular about 1909. It was sufficient for everybody that the period of depression had gone by and that normal conditions were again in sight. Below we append an estimate for 1909 as compared with that which we gave for 1908:

	1908.	1909.
Electrical apparatus	$250,000,000	$275,000,000
Electric railways	350,000,000	475,000,000
Central stations	225,000,000	250,000,000
Telephony	200,000,000	250,000,000
Telegraphy	50,000,000	60,000,000
Isolated plant supply	75,000,000	75,000,000
Miscellaneous	40,000,000	50,000,000
Totals	$1,190,000,000	$1,435,000,000

The figure for 1908 was below our estimate for 1907, which was $1,255,000,000. We have very little hesitation in giving our estimate for 1909 as to the production of apparatus and income from service as being $1,435,000,000. There are two adequate reasons for the apparent big jump between the two recent years. One is that the estimate for 1908 was set by us too low in regard to electric railways, and the other is that it has been possible to revise the whole series by the United States census figures for 1907. It thus happens, for example, that total street railway earnings for that year and 1908 were gaged by us at $350,000,000 per annum, wheras the Government returns show them to have reached not less than $430,000,000 in 1907. That being the case, our estimate of $475,000,000 for last year is moderate. Again, the census statistics for 1907 showed that in gross income the telephone actually outran the central station by a few millions. But the "independent" telephone boom has not continued with anything like the same vigor, while the central-station art has made a tremendous rally in the two years. It seems safe to allow for each earnings of $250,000,000, although that makes the independent telephone earnings equal to the Bell, which is doubtful. To the electric light earnings should be added the value of the isolated-plant service. This we regard as stationary, for while many new isolated plants go in, the number taken over onto central-station circuits may offset them, if there is any reliability in the data available. The miscellaneous uses of electricity have undoubtedly increased during the past year. The growing resort to electrotherapy may be mentioned, for example, inclusive of Roentgen-ray work. The amount of miscellaneous electrical work required for new hotels, theaters, apartments, factories, steamships, etc., is remarkably large, altogether aside from any of the items considered above; and the past year has witnessed great activity in new buildings, all of it making a demand on the most varied electrical apparatus and service. It might be mentioned, moreover, that none of the above figures include the suburban and terminal transportation work done by main lines of steam railroads with electricity. That amounts already to several millions, and is just as strictly electrical as the operation of an incandescent lamp or a fan motor. Nor do the figures include the telegraphic work of the railroads and the Government. A number of unclassified, unenumerated items of this kind could be named, all going to swell the totals.

Rather than reduce our grand total, therefore, for 1909 we should feel inclined to increase it somewhat, and make it, in round figures, not less than $1,500,000,000. We are probably low on every item, for even electrical manufactures might without risk be estimated at $300,000,000, although we have preferred to put it $25,000,000 less for the reason that, in general, due perhaps to cheaper copper, prices have been below those of former years in many lines. Moreover, prices have been reduced by the production of larger units. The introduction of the tungsten lamp has brought in a high-priced article to compete successfully with a low-priced one, and as one consequence estimates of lamp production are put by some as low as 75,000,000, although others are inclined to accept a much higher figure as reasonable. Although these new lamps have had a perceptible effect on central-station loads already connected, it is safe to assert that the gross output of electrical energy has gained steadily owing to the new loads, both of lighting and of other kinds of service. All told, 1909 has been a quietly profitable year for the industry as a whole, and the case of the street railways shows that even in despondent, dull years like 1907 and 1908 there is an unsuspected but unmistakable gain. As for 1910, we expect to see it break every electrical record.

THE CENTRAL STATION.

Central-station practice during the past year has been making haste slowly. There have been, so far as equipment is concerned, no especially radical changes, the chief thing worthy of note being the steadily increasing use of turbo-generators of the larger sizes. For the rest, the chief interest centers in the newer lamps, both arc and incandescent. The use of the metallic-filament lamps has increased enormously, so that in many plants, both large and small, the increase of connected lamps is in no small measure composed of such units. Yet

as a matter of fact, the aggregate proportion of tungsten and tantalum lamps in use in any of the larger central stations of the country is really small, probably not over 15 per cent in any instance and generally under 10 per cent. Tungsten lamps commonly get in rather conspicuous places, so that these modest proportions show for more than they are worth in going about a city. In factory output, the tungsten enters for little over 30 per cent. The quality of tungsten lamps has shown material improvement during the past year. The sorting of the commercial product, however, leaves very much to be desired. Such lamps are not yet made with anything approaching the uniformity of the old carbon lamps, and until they are used on a very much larger scale, proceeding from factories of greatly increased output, this trouble in sorting is very likely to continue.

There are fewer complaints of excessive fragility than there were a year ago in spite of the very large number of 25-watt tungsten lamps now in use, roughly, perhaps, one-half of the whole. In passing, it may be remarked that the tendency toward tungstens of less than 40-watt rating is distinctly adverse to the best interests of the electric lighting industry and indicates a lack of appreciation by central-station men of a situation introduced by the tungsten lamp which should have been fostered.

Nothing definite has yet appeared in the way of a competitor of the tungsten lamp, or in the way of very marked improvement in its quality. It is persistently reported that some very radical improvements are on the way, especially as respects the character of the filament in the tungsten lamp. Whether such improvements are not yet commercial, or being very gradually developed as a matter of policy, has not yet definitely transpired. One of the things which seems to be impending in incandescent lamp practice is a more extensive use of the low-voltage tungsten lamps, particularly for residence work. We have dealt with this question before and must reiterate the opinion that such practice is only a passing phase of development, but yet it may be a useful resource for some few years to come. The tendency is to use lamps of 50 volts to 60 volts, worked on a tertiary transformation. The loss in the little auto-transformer used for this purpose is very small, only 12 watts or 15 watts constant loss, in ordinary sizes, and the convenience gained is decidedly worth the trouble. At this voltage, especially if the lamps are worked at very slightly lower efficiency than the usual 1.25 watts per candle, the life is very long, say, in the neighborhood of 2000 hours, and the great advantage is gained of having lamps of moderate candle-power which can be burned in any sort of situation around the house without worrying over breakage. From the standpoint of the central station the practice is unobjectionable unless carried to so large an extent as to interfere somewhat with the regulation. The use of smaller lamps at the lower voltage, confined as it is likely to be very largely to smaller residences, will not imply any material loss of output, since the ordinary station depends at present very little on its income from domestic lighting, and to offset this, customers, on the whole, will use light more freely and pay their bills more amiably if the replacement costs are low. How far the practice, now being rapidly introduced in Hartford, Conn., of furnishing these low-voltage tungsten lamps for residences at contract rates and with free renewals, is likely to increase, remains to be seen. The scheme appears to have worked well in Hartford, but whether it is equally applicable elsewhere only time will show.

Arc practice has been moving steadily along in the lines marked out last year. The path of progress is in the direction of powerful luminous arcs and, to a certain extent, flaming arcs for street lighting, and intensified carbon arcs for commercial lighting. Several cities, notably Boston, have gone over quite completely to the use of magnetite arcs of more than the usual power, and large flame arcs are beginning to make their appearance for lighting of squares and public places. The tendency toward the use of opal globes instead of clear globes in these later forms of arc is decidedly strong, to the great improvement of the illumination on the street. There has been too vigorous a movement in favor of brilliant street lighting through limited sections of some of the larger cities, and excellent examples are to be found in New York, Newark, Baltimore, Denver and elsewhere. How far this tendency is a permanent one is, of course, uncertain, but it looks very much as though there was gradually forming just that distinction between important and unimportant streets, which is so marked in the illumination of foreign cities. It seems probable here that local intensification of light will be eventually accompanied with better general illumination than is commonly found abroad. The tungsten street lamp tends powerfully to this good end, as the ultimate result may be the use of arcs chiefly for the most brilliant illumination, and of tungsten lamps for all the subsidiary work. This plan of operation is now being carried out in Hartford, and there are very evident signs of similar tendencies elsewhere. Central stations seem to have been keeping up their earnings well, thanks to the introduction of metallic-filament lamps with the constant tendency to increase illumination all along the line, which should be nursed by the substitution wherever possible of high-candle-power tungstens for 16-cp carbon filaments.

This brief review should not be closed without making reference to the most beautiful and distinguished results obtained during the temporary illumination of the Hudson-Fulton Celebration. The temporary lighting for this occasion was certainly the finest exhibition of display lighting that the world has yet seen, thanks to the modern resources of the central station and its energy in employing them.

THE SMALLER CENTRAL STATION.

There have been no radical developments in connection with small central stations in the past year, but several tendencies which have been noticeable for some years are becoming more pronounced. It is, perhaps, being better realized than formerly that electric lamp and motor service in small towns can be made profitable under proper policies, proper financing and proper operating management. The methods of increasing the net profits of such small enterprises can be classified generally under two heads: First, combining several central stations so as to obtain a centralized power supply; second, combining other functions with that of the local electric light and power station. The number of small towns supplied by single-phase transmission lines of light construction connecting these towns

with some central station in a large town is constantly on the increase. In some cases the distribution system in a small town is owned by the central-station company, and in other cases energy is purchased from the central station. In either event the economy of energy supply, as compared to the energy supply from a very small station, is very marked. The combination of several kinds of public service in one power plant has, in a number of notable cases, caused such an increase in net return on the investment as to put such enterprises entirely out of the class of the ordinary small electric light and power plant. The combination of electric lighting and city water pumping is a good one and has been practised to some extent for years. One of the most profitable combinations in towns where there is a demand for ice in summer and for artificial heat in winter is that of electric light and power, exhaust-steam heating and ice manufacture. Most small central stations operate non-condensing, which gives a by-product of exhaust steam containing 95 per cent or more of the heat units in the boiler steam. This exhaust steam can be condensed for ice manufacture in the summer and condensed by the heating of buildings in the winter, thus utilizing the central-station by-product, both summer and winter. Of course, a combination of this kind presupposes some all-day load. However, with such uses for exhaust steam it pays the station to operate all day; otherwise it would have to put out live steam almost as great a fuel expenditure.

Another encouraging development of the year for those interested in small stations is the increasing number of successful producer gas-engine stations. The small central station operating with gas engines and producers fired with anthracite coal is now on a well-established basis, and where there is no market for exhaust steam can, over a considerable portion of the United States, produce energy at a lower cost, all things considered, than is possible with small steam engines. About the only places where the small anthracite producer-gas plant is excluded are those very near to soft-coal mines. Within the past year a notably successful run has been made in a small plant using bituminous producers, as noted in these columns recently. With a successful bituminous producer, the field of the gas engine is very much enlarged; and as the relative economy of the gas engine, as compared to the steam engine, is much greater in small plants than in large ones, this gas-producer development is of especial interest to the small plant. In connection with transmission lines between small towns, there is an increasing number of electrically equipped farms. It is now possible to obtain step-down transformers at reasonable cost for taking energy from high-tension transmission lines of 6000 volts to 15,000 volts, and this will probably result ultimately in a considerable extension of the use of electricity by farmers. This scientific study of the economics of the small central station is more apparent than formerly, as indicated in part by the central station "facts and factors" which we have been enabled to publish by the courtesy of various managers during the past year. A table of similar factors compiled by a committee of the Iowa Electrical Association for its last convention shows results from 26 stations in that State. We understand that the Ohio Electric Light Association is to take up similar work next year, and other vigorous State bodies will doubtless follow suit.

ELECTRIC ENERGY TRANSMISSION.

The past year should go down in the annals of electric energy transmission as the one which has tested out the use of voltages exceeding 100,000 in a conclusive manner. The plants of the Grand Rapids & Muskegon Power Company and the Central Colorado Power Company have now been in operation for a sufficient length of time to bring out such working difficulties as might reasonably be expected to occur in the use of 110,000 volts or thereabouts. The net results have been that the service at this pressure is on the whole as reliable as the more usual voltages of 50,000 or 60,000, and that difficulties fairly chargeable to the very high pressure have been mainly conspicuous by their absence. This is altogether in keeping with recent experience in high-tension engineering, which has shown quite conclusively that the imaginary perils are far greater than the real ones. It is difficult to overestimate the importance of establishing on a commercial footing these very high pressures, for upon their employment must depend not only the economy of ordinary transmissions over considerable distances, but the practicability of establishing very extensive networks, highly desirable for the efficient utilization of groups of water-powers.

The success of these installations is very largely due to the suspension type of insulator, which renders it possible to get first-class insulation even in very bad weather without introducing insulators of unmanageable and unmechanical character. It is very doubtful, indeed, whether any pin-type insulator yet devised will stand a protracted wet test at 100,000 volts, while it is perfectly certain that the suspension insulators used in the plants referred to are doing so. As to the general nature of the installations made of late, their purpose has usually been general distribution, commonly at wholesale, and the types of apparatus have undergone very small changes. A recent foreign practice, which we describe in these columns, has been the use of extremely high voltage in the generators. Whether this is an example to be followed is another matter. Most American engineers, we fancy, would hold to the negative of the proposition, considering the cheapness and reliability of transformers. Nevertheless, as an advance in practical dynamo insulation, the step is a somewhat noteworthy one. It is worth remarking that in spite of the interest abroad in energy transmission by constant continuous current, no notable plants have actually been installed of late on this system. With the demonstrated success of 100,000 volts or more used in the ordinary way, the necessity for the constant-current system is very much diminished. One thing, however, must be said for this latter system —that while the dynamo plant is a little more complicated than is customary in American practice, the switchboard plant is of rudimentary simplicity.

There are some signs in our country of a reactionary tendency against the switchboard complications of some recent plants, and we are disposed to think these installations gain by simplicity not only in cost of installation, but in that reliability, which is one of the most important assets of the transmission system. It is a little hard to say just what reliability actually means from the standpoint of modern practice. On some trans-

mission systems there have been bitter complaints of the uncertainty of service and in some instances such complaints are only too well founded. We have recently examined a record of interruptions of service on one considerable system extending over an entire year. The net result was 112 shutdowns of service, varying in length from half a minute to half a day. A large proportion extended only over a few minutes. Most of the longer interruptions were chargeable to trouble on the line, due to storms, broken insulators and lightning. The record is imperfect as to the shorter interruptions, but quite a few of them seem to have been due to troubles with the switching apparatus and other power-house sources of difficulty, probably superinduced in many cases by minor troubles on the line. The record is a somewhat disquieting one and would be more so were it not for the fact that the troubles recorded were very irregularly distributed, with intervals of several days or even weeks of entire freedom from trouble, followed by difficulties every day over a short period and sometimes several times a day. The moral of such a list of troubles is that the average line, even when supposedly well built, is not sufficiently defended against accident, and also that a keen outlook should be kept in stations against minor parts which ought to be protective and are not.

The best defense against line troubles is absolute duplication of the lines, not merely duplication of circuits, for experience has shown when two or more circuits are put on to the same pole or tower, trouble with one is not unlikely to involve the other. It is possible to put up a pair of single-circuit lines on properly designed latticed steel poles for a sum not greatly in excess of ordinary tower construction when accommodating two circuits, and the gain in safety is very considerable. Indeed, where the independent circuits are not very heavy, even a duplicate pole line of first-class wooden poles is not to be despised. When several plants are arranged on a suitable network, a far greater degree of reliability is insured than in some plants working independently, and thereby line construction can be very considerably economized. As energy transmission comes to be more and more developed, serious line troubles will undoubtedly be almost eliminated by the use of duplicate lines and networks. Trouble in the power house itself is strictly remediable so far as the vast majority of the sources of trouble are concerned, and we believe that simplicity and accessibility are the watchwords which should be borne in mind in power-house design. There are systems which operate for months at a time without interruptions of service, but such a record is secured only by combination of first-class construction and eternal vigilance.

THE ELECTRIC RAILWAY.

Few, indeed, have been the developments in electric railways during 1909 which could not have been predicted at the beginning of the year. Nothing of a revolutionary nature has occurred, but much progress has been made along conservative lines. A notable example of conservatism was the selection of 600-volt, direct-current locomotives by the Pennsylvania Railroad Company for its New York terminal service, where many engineers believed either single-phase or high-voltage direct-current equipment would be used. The choice of an installation operated at the standard low-voltage employed in street-railway work was stated to have been dictated largely by the desire to render the new equipment interchangeable with the existing equipment of the Long Island Railroad, and should not be considered as indicating a lack of faith in the single-phase and high-voltage direct-current installations. If the electrification problem had been one of through traffic rather than mere terminal work, it is safe to state that one of the other traction systems would have secured adoption.

From many points of view the most noteworthy event in the electric railway field during the past year was the placing in service, for the first time in America, of three-phase locomotives under extremely severe steam-railroad conditions. The operation of these locomotives in the Cascade Tunnel of the Great Northern Railroad Company confirms the experience on European roads, showing that for absolute reliability in service the three-phase equipment is above criticism. Many of the features of the three-phase traction system which some American engineers were inclined to consider as disadvantageous for heavy duty, have been found to be either quite advantageous or of minor importance. For example, the constant-speed characteristic of the polyphase induction motor has not proved disadvantageous, but is expected to result in economy on account of the energy which will be restored to the supply system when descending grades.

Moreover, the ability to make up for lost time, which is claimed exclusively for motors possessing series characteristics, does not point to any marked inferiority on the part of constant-speed motors, for the latter are much less liable to lose time than are the former. The constant-speed characteristic will affect the schedule less than the power house. It is to be noted in this connection that at the particular part of a system where the generating equipment might be expected to be overloaded on account of the constant-speed feature of the induction motors—that is, on grades—the load may even be actually less than with direct-current motors by reason of the energy returned by the train descending the grades. However, so far as concerns its torque-speed features, the induction motor is directly comparable with the direct-current shunt-wound motor, which has met with little favor when proposed for railway service. The one prominent disadvantage of the three-phase traction system from the standpoint of American practice is the necessity for two overhead conductors. For locations such as the Cascade Tunnel, and where only single-tracks or double-tracks are encountered, the installation of two separately insulated contactor wires does not present difficulty, but for service around railway terminals and yards quite another set of conditions is encountered.

Although several single-phase railway installations have been replaced by direct-current installations during the year, it may well be said that the compensated-series, single-phase railway motor has held its own and is more firmly established than ever. When properly installed for railway service without any reference to existing systems so that the desirable low frequency can be employed and direct current need not be used—as on the

Visalia (Cal.) road—the service obtained is highly satisfactory. The chief event of the year relating to single-phase railway equipments was the frank discussion of the troubles encountered on the New York, New Haven & Hartford Railroad by the engineers of that road. What had been considered the weakest element in the system—namely, the single-phase motor—proved absolutely trustworthy, although almost every other detail was altered before the installation as a whole was considered satisfactory. Those in position to know best of the service rendered are enthusiastic advocates of the single-phase motor for traction under steam-railroad conditions. Moreover, the New Haven company has shown its satisfaction with the single-phase equipments by arranging for the installation of single-phase motor cars for its suburban service. It has been announced that the Rock Island & Southern Railway Company has selected for both freight and passenger service a purely single-phase equipment which will doubtless operate to even better advantage than the New Haven equipment, which is somewhat handicapped by being compelled to operate at times over direct-current circuits.

A type of traction system which is comparatively new, and has made much headway during the past year, is the 1200-volt, direct-current railway. A recent compilation showed a total of 11 roads in operation or nearing completion, representing 380 miles of track, over which 152 1200-volt motor-cars will be run. There can be no doubt whatever as to the success of this system and as to its advantages over the 600-volt system for suburban and interurban service. This success is attributed largely to the use of interspaced commutating poles on the motors, by which sparking has been eliminated and brush wear reduced to the minimum set by friction and heating. The excellent performance obtained from the motors in service would indicate that still higher e.m.f. may be reached, and it is safe to state that 2000 volts with two 1000-volt motors in series can easily be obtained. However, there are features other than the possible e.m.f. at the motor which determine the e.m.f. to be used on the trolley. In city service 600 volts has been, and will long remain, the standard. For interurban service double this e.m.f., with the motors in series, may seem a logical value. However, cases may arise where 1000-volt motors could be connected two in series for operation at 2000 volts in interurban service and joined in parallel for lower-speed city service when reaching the 600-volt trolley circuits. Many facts point to continued developments in the high-voltage, interpole, direct-current motor for railway service.

Concerning the three types of equipment used in this country, it is encouraging to note that the advocates of each are the ones most familiar with the particular system championed. In the line of heavy railway work, the direct-current installations have proved thoroughly satisfactory for terminal service, the single-phase has to its credit a good record for high-speed passenger service, while the three-phase installation cannot fail to maintain its record for reliability under the most difficult steam-railroad conditions. The fact of the matter is that any one of the systems can show marked improvements over the best steam-locomotive service, and they differ among themselves by only a small percentage when considered for the average service. Under special conditions one system may be pronouncedly superior to the other, but when the single-phase system is not burdened with devices for direct-current operation, the direct-current system is not subjected to local voltage limitation, and the three-phase installation is not required to perform switching service around yards, it would be difficult for one to make a selection between them for general heavy railway service.

THE STORAGE BATTERY.

In the storage-battery art improvement continues satisfactorily, both with respect to the elements and the auxiliaries. The most marked improvement in recent years is the permanizing or impregnating of the negative plate, which process was independently and almost coincidentally developed by inventors connected with three of the leading storage-battery companies. Planté negative plates lose capacity in the course of time and prior to the advent of the permanizing process it was necessary to make the elements with an excess capacity in the negatives, this surplus being often as high as 100 per cent. In spite of this high initial capacity, the output of negatives tended to decrease, and in some cases plates within two years would be unable to supply their rated discharge, and within three or four years had to be replaced. One process consists simply in soaking a plate in some solution of a solid, which may be carbonized, such as sugar. After the pores of the active material are filled with the solution, the plate is heated until the sugar is carbonized and the pores are thereby prevented from clogging or closing up. The capacity, therefore, remains constant, and so far as can now be determined, the life of the negatives so treated is indefinitely long. Curiously enough, an old negative plate so treated regains and maintains its capacity. The use of pasted electrodes diminishes with the passage of time, and now that the pasted negative plate is becoming no longer necessary to maintain the cell capacity, it is threatened with extinction. The greatest factor which has limited the use of storage batteries has been the initial cost and the high annual charges for depreciation and maintenance. During the past two years prices have been materially lowered and the life of the negative plate indefinitely prolonged, so that the interest, maintenance and depreciation have all been greatly reduced. A broader field for the application of batteries is thus opened and the number and size of battery installations will undoubtedly increase.

The use of storage batteries, connected across the exciter busbars of large alternating-current generating stations as insurance against interruption of service, has now become so universal that it may be considered conventional. Among the new auxiliaries, the high-speed end-cell switch and the split-pole rotary converter are the most important. The necessity for quick changes in the number of cells in a circuit so that the voltage of the line may be kept constant under rapid load changes, caused the development of the high-speed end-cell switch. This device differs from the motor-driven switches of former years only in the increase in the size of the motor, in the gearing ratio and in certain of the electrical connections to the motor, the switch itself being unchanged. The speed of movement from contact to contact is about three times as great as that of the standard switches. The split-pole rotary converter, which has been fully described in this journal, has a portion

of its field excitation controlled by an automatic device and differs from the ordinary rotary converter in that the voltage ratio between the alternating-current and direct-current sides is variable and may be changed by varying the field excitation of the automatically controlled poles. This machine also works as well when running "inverted"—that is, when receiving direct current and delivering alternating currents—as when working in the reverse sense. Therefore, with the automatic field-controlling device connected in an alternating-current circuit and working with load changes in the circuit to vary the field excitation of the rotary converter, and a storage battery connected across the brushes on the commutator side of the converter, load fluctuations on the alternating-current circuit will be equalized by the battery. When the load is light the commutator voltage of the converter is high and the charge is sent into the battery; when the load is heavy, the commutator voltage is lowered and the battery discharges to the converter, which delivers alternating current to the line in parallel with the current from the source of supply, and thus assists in carrying the excess load.

Installations of these variable-voltage rotary converters with batteries have proved successful and regulate variable alternating-current loads within a few per cent. The same result may be accomplished with an ordinary rotary converter adapted to work inverted and an automatic booster between the battery and the converter commutator brushes, the field excitation of the booster being varied responsive to load changes in the alternating-current circuit. In small installations the cost of both a standard rotary converter and a booster made on a standard dynamo frame would be less than that of the specially constructed split-pole rotary converter; but with large equipments the split-pole converter will probably cost less. The efficiency of the split-pole converter would, of course, be higher than that of the combined efficiency of the standard converter and the booster, though not much more, because the efficiency of the ordinary converter is greater than that of the split-pole converter. Since the regulation of both alternating-current and direct-current loads by storage batteries has become ordinary practice, and the great desirability of battery equipments in connection with gas-engine installation is now recognized, the impending industrial prosperity will without doubt be largely shared by manufacturers of storage batteries. Another increasing field for their product is the electric vehicle, which is subject of notice in another column.

THE TELEPHONE.

On the technical side of the telephone industry there have been no developments this past year of an epoch-making character. The industry as a whole has shown a healthy growth, and the manufacturers have been busier than during the preceding two years. They have, however, on the whole, contented themselves with bringing out improvements in design rather than any radical devices or changes. Such improvements must not be underestimated as of value in the art, as they are continually necessary in order that the cost of giving service may be reduced to meet the popular demands for lower rates. In switchboard design little has been done. The semi-automatic is still attracting the chief attention. The so-called automanual board has this year been put into commercial service in one locality, and is reported to be giving satisfaction. The call-distributing system is also receiving its full share of attention. With this are included those semi-automatic systems wherein arriving calls are automatically apportioned to the various operators so that there need be no delay in obtaining an operator's attention even though a number of calls arrive simultaneously.

With the growing importance of the long-distance service there is a natural interest in factors likely to affect its efficiency. In this category falls the telephone repeater, announcement of the commercial attainment of which was made a year or two ago. The repeater principle was discovered in the early years of the telephone, but in spite of the fact that inventors were made well aware of its value through the sensational offering of an enormous but doubtful prize for a successful repeater, and in spite of a vast amount of work, their efforts were in vain. It therefore seems all the more strange that the successful apparatus should be but a refinement of the repeater first suggested. Improvements in the commercial repeater have not been very rapidly introduced, and it seems almost as if its progress will be as slowly accomplished as was the reduction of the first suggestion to commercial requirements. The reason for this probably lies in the very minute limits of mechanical and electrical action and the consequent difficulty of studying the factors. Thus far the repeater is strictly an intermediate apparatus adapted for permanent connection in a through line, it being necessary to adjust each repeater to the electrical constants of the sections of the line on either side of it. The chief improvement thus far seems to have been an increase in the allowable unbalance of the two line sections.

On the financial and commercial side of the industry, there have been many changes. One of the most important of these is the acquiring of telegraph stock by the telephone interests. In the early days of the telephone, the Western Union was the greatest rival of the Bell, and the supremacy of the latter was only established after a hard fight, and the acceptance of an agreement defining certain limits beyond which telephone operation should not be extended. It is but natural, therefore, that after all these years of co-ordinate operation in their respective fields, the public should be interested in any movement of one to obtain control of the other, even though, as officially announced, the control recently obtained be only "of a substantial minority interest." There seems to be no doubt that great economies could be effected by the combined operation by a single organization of the telegraph and telephone business, as not only would the circuits be available for the simultaneous transmission of both telephone and telegraph messages, but the pole lines of each system could be used to carry the circuits of the other, and offices could be used in common. It is impossible to foretell the final outcome, but the trend of the times certainly indicates that, in the future, there will be an actual merging of the properties in so far as the operation of the plant is concerned. A similar tendency is indicated by the policy of the Bell Company in carrying out the merging of smaller companies into larger ones. The latest example of this is the

organization of the new New York Telephone Company, embracing that entire State. In the Independent field occurrences of the year were dwarfed by sensational events at its close, arising through the purchase of large Independent properties by men who were obviously merely hired agents of some great interest. The mystery surrounding the transactions was finally dispelled by the announcement of J. P. Morgan & Company that they were the principals in the purchases. The accompanying statement that there would be no important change in the policies of the Independent companies involved in the deal most probably applies to the immediate present. As it is doubtful if the Morgan interest will, in view of its relation to the recent Western Union-Bell transaction, become the head of an Independent telephone group, it is generally believed that the properties will eventually pass into the hands of the Bell interest. The incident is discouraging to the friends of the Independent movement through indicating the lack of solidarity in that field, which weakness, from time to time, becomes evident when a choice is offered between the almighty dollar and adherence to a cause to which telephone users are exhorted to rally as one involving a patriotic principle.

ELECTROCHEMISTRY.

While the older electrochemical industries, located principally at Niagara Falls and engaged in the manufacture of carborundum, artificial graphite, calcium carbide, caustic soda, chlorine, etc., have been flourishing and steadily growing, by far the most interesting feature of electrochemical development during the past year has been the energetic entry of electrochemical methods into new metallurgical and chemical fields—the iron and steel industry, on the one hand, where the electric steel refining and the ore-smelting furnace have secured a permanent status, and, on the other hand, the more strictly chemical industry, where the manufacture of fertilizers and explosives from the fixation of atmospheric nitrogen has taken great strides. These developments have followed in a strictly logical way the lines of least resistance. In the steel industry the very expensive crucible process of steel refining represented a weak point commercially, and it was the first to yield to an electric process, the pioneer electric steel plant of the Halcomb Steel Company, of Syracuse, having been running now successfully for a number of years. In this respect, however, developments in Europe have been even more rapid. It is safe to say that a considerable portion of commercial "crucible steel' is there now made not in crucibles, but in the electric furnace. Of much greater commercial importance, however, is the development in which the United States Steel Corporation has taken the lead during the past year; namely, the electric refining of steel for large-tonnage products, such as rails and wire. The first two installations are at South Chicago, where the Héroult electric furnace is used for refining molten steel supplied from Bessemer converters, to make rail steel of improved quality; and at Worcester, where the process is used in connection with the open-hearth furnace to make steel especially for wire. The Worcester plant is to start operation early in January, 1910, while the South Chicago plant has been working continually since last summer. There has been considerable trouble in getting durable carbon electrodes that would withstand usage in the 15-ton furnaces, the largest steel furnace now in existence. But metallurgically the results are stated to be highly satisfactory, and it is believed that when all the little details have been sufficiently worked out and the workmen have become familiar with the process, the electric refining furnace will be found equally as reliable and fool-proof as the Bessemer converter. In fact, it is reported that plans are already being perfected for great additions to the electric steel furnace plant.

From a commercial standpoint the electric furnace, as an auxiliary to the Bessemer converter, seems to have solved a problem of great magnitude. In recent years the demand for better steel has become more and more urgent, and as a result consumers have become accustomed to specify open-hearth steel in preference to converter steel in spite of the higher cost of the former. Many, in fact, have prophesied that the Bessemer converter is doomed to extinction. It is at this point that the electric refining furnace comes to the rescue. For if the combination of Bessemer converter and electric refining furnace can produce as good, or better, steel than the open-hearth at the same cost or less—and there seems to be no doubt that this is possible—the electric furnace is destined to give the Bessemer plants a new lease of life. With respect to electric smelting of iron ore, it is generally recognized that competition with the blast furnace, where the latter is now established, is economically impossible. But the case is held to be different in localities where the conditions are favorable to electric smelting through availability of cheap water-power, and unfavorable to blast-furnace operation through lack of cheap coke. If such a locality has a good market for iron, and is also rich in iron ores, it is believed by many that the electric furnace smelting has there a good chance of success. The attempts which have been made in California and in Sweden on a large experimental scale in this direction have given results during the past year which promise to bring the process into use on a commercial scale, not only in the localities mentioned, but pre-eminently in Canada. The technical problems still to be solved relate to details of furnace design, although the general design of the shaft furnace seems to be fairly well worked out, the Swedish and California furnaces, although independently designed, being quite similar in general appearance.

With respect to the enormously important development in the fixation of atmospheric nitrogen for the manufacture of nitric acid and nitrates for fertilizers, there are now three processes in successful commercial operation. The Birkeland-Eyde process passes the air through an arc disk produced by magnetic deflection of an arc. The process of the Badische Company uses a long enclosed arc (16 ft. to 20 ft. long) around which the air passes in a helical path. The Pauling process uses an arc arrangement quite similar to that employed in the familiar "horn" lightning arrester. The first two processes are in use in Norway, the latter in Tyrol. This location of plants is significant, as it indicates that commercial success requires very cheap water-power. The chief raw material, the atmospheric air, is available everywhere and costs nothing. But the process itself is not inexpensive; it requires considerable electrical energy, and it is doubtful whether the energy consumption can be reduced much below that obtained in the three successful processes named; furthermore, the purely

chemical working up of the very dilute nitrogen oxide gases into concentrated marketable products is quite complicated and expensive, although further improvements are distinctly possible in this direction. It is reported that a Southern power company is seriously considering the erection of a plant for the fixation of atmospheric nitrogen. Whether it can afford to do so in view of the commercial limit of electric energy transmission being now at least 200 miles, is an open question; but if the process should be commercially possible in this country, the South with its vast market for nitrogeneous fertilizers seems to be the logical place for its application.

THE ELECTRIC VEHICLE.

In taking account of the record of the year 1909 in electrical advancement, the electric vehicle and its relation to the central station must not be overlooked. The electrically propelled automobile for pleasure service or commercial purposes has been in existence for nearly 20 years. During that time it has developed from a mere curiosity to the foundation of a business which supports numerous important factories, and which turned out vehicles to the number of perhaps 4950 in the year 1909, these cars and wagons of one year's production being valued at about $10,500,000. A glance at these figures shows that, despite some early imperfections of its own and despite indifference from quarters where self-interest would apparently insure friendly co-operation, the electric vehicle has "made good." It is here to stay, and is to be reckoned with by all interested in the automobile or electrical business. That its existence creates a not-to-be-despised demand for certain classes of electrical apparatus was brought home to some storage-battery makers during the financial stringency of 1907 and 1908, when orders for large batteries for power plants were rather scarce, but the humble electric vehicle held up nobly.

The electric vehicle until recently made its way without much assistance from the operating electrical interests. Central-station men, with many other things to think about, did not bother their heads very much with the electric "auto" or power wagon. Many of them were skeptical of any substantial benefit to be derived from pushing the use of electric automobiles. The electric vehicle was, to a considerable extent, distrusted, owing perhaps to discouraging experiences by owners upon its advent years ago. In some cases these owners were electrical men themselves. After an annoying experience with battery troubles or with mechanical imperfections in the design of the vehicle itself, many owners "threw up their hands" and decided to let the electric car alone. Further, the great preponderance of the gasoline machine in the automobile field caused the electric type to be overshadowed. Garage owners, too, were frequently unsympathetic and gave their allegiance mainly to the gas car; indeed, the prejudice or ignorance of the garage men has had not a little to do in creating difficulties for the electric vehicle. The year 1909 has witnessed an awakening on the part of the electrical interests to the importance of the electric vehicle. The "get-together" spirit has been manifest. It has been realized to an increasing extent that the motto, "All together all the time for everything electrical," should include the fostering of the electric vehicle. A prominent manufacturer of batteries has, to its credit, conducted a widespread educational campaign with good results. The Society of Automobile Engineers gave more consideration to electrical subjects than ever before, and the National Electric Light Association devoted considerable attention to the situation at its convention last June. The electric automobile census published in these columns last August opened the eyes of many to the importance of this field. Many central-station companies have exhibited a new interest, or a revival of interest, in this subject, and are now making intelligent and systematic effort to increase their battery-charging load by encouraging the use of electric vehicles.

There would appear to be every reason why the electric service companies should favor the extended use of electric automobiles. If there are 20,000 vehicles of this description in use in this country to-day (and the makers give a higher estimate), and if this number is divided into 18,000 pleasure vehicles and cabs and 2000 delivery wagons and trucks, a rough approximation can be made of the value of the electric energy supplied for operation. Let us assume the low average of $90 worth of electricity to charge the battery of each pleasure vehicle for a year's operation and $210 as the corresponding figure for the commercial vehicle. Then the year's bill for electricity for automobile operation amounts to $2,040,000—a respectable amount of business, and one which is bound to be greatly increased. Some portion of the electricity for charging vehicles is generated in private plants, but by far the greater part comes from the central station. Furthermore, the business is of a desirable nature. Most automobile charging is done at night, and for fairly long hours. It is an off-peak proposition and improves the load factor. Again, the greatest demand is during the summer months, when the lighting load drops off. Central-station companies can afford to encourage the business by making attractive rates and by co-operating with owners to make the operation of the vehicles successful and satisfactory. One great difficulty with the electric vehicle in the past is that owners have expected the battery to work with practically no attention, as it will do perhaps for a few months. There are only a few precautions to be observed in the case of vehicle batteries for good service, but these are essential. Care should be taken to use only pure water in replacing evaporation, to keep the specific gravity of the electrolyte up to standard, to keep the electrolyte at the proper height above the plates, to wash out the sediment in the cells at frequent intervals and not to allow the battery to stand completely discharged. When charging is done on the customer's premises it should be under the supervision of some one man, who should familiarize himself with the operation and be held responsible. A frequent cause of failures in the past has been that no one in particular has had charge of the customer's battery, and, from ignorance and lack of responsibility, trouble has resulted.

In the practical care of batteries the central station can be of great help to the vehicle owner and so foster its own interests in a very practical way. The electric service company should have at least one man on its staff who is enough of a battery expert to diagnose and cure the ordinary vehicle-battery troubles. Letters may be sent to vehicle owners, as is done in

Chicago, saying that the company wants to advise and help them in practical problems of electric vehicle operation. In that city the company will send its expert to examine an ailing battery. The man sent will go into the subject thoroughly, taking the battery apart if necessary, and will make a report to the owner. Further, the company stands ready to give advice to customers on the general characteristics and performances of electric vehicles. No charge is made to customers for this service. It is realized that the great mistake of the past has been in not caring properly for vehicle batteries. Progressive central-station companies are now alive to the fact that they must help their customers to care for their batteries intelligently to retain existing business and to increase it. It is simply the application of the helpful "special service" principle which is coming into use in so many departments of modern merchandising—not only to sell a thing, but to drill the purchaser in the proper use of the thing sold, looking at the matter from the purchaser's point of view. In St. Louis a central-station company has itself operated an electric garage for two years. The building is in the residential district and has a capacity for 80 pleasure vehicles. The venture has been entirely successful, and during the year just closed it was decided to open another in the business district for commercial vehicles to have accommodations for 60 rigs. In New York there are about 900 electric vehicles in service—nearly half of the entire number in the country—and they are doing good work. The central-station company in Chicago has itself 16 electric delivery wagons on the streets, and a long series of records shows that they are operated at about 85 per cent of the expense of maintaining horse-drawn vehicles of equal capacity. Rochester, N. Y., is another city where the electric vehicle situation is taken seriously and with satisfactory results in income account. Boston has also paid much attention to the electric vehicle, and the same is true of Minneapolis and a number of other cities that might be mentioned. In a few of the smaller cities the central stations themselves sell electric cars to customers.

Beyond question there is a great field for the extension of the use of electric automobiles, and central-station companies will do well to give the subject careful study. But it is to be remembered that all possible friendliness and co-operation on the part of the electrical operating interests will be of little avail unless the manufacturers turn out first-class vehicles which will stand up under the strain of daily operation. The electric vehicle has been criticized in the past, and in some cases justly, because of faulty design and workmanship. Several greatly improved types are now available, and probably the central station could give some valuable hints to the prospective customer in making his selection. This is a delicate subject, however, and in considering it each plant manager must determine for himself how far he will enter into it. Speaking broadly, however, the central station has the right to demand of the vehicle manufacturer an approved product if he be expected to advocate the use of electric automobiles with energy and enthusiasm. While not well adapted to unpaved country roads, and limited by the periodical necessity of recharging the battery, the electric vehicle has many points of advantage owing to its simplicity and ease of operation. In the case of trucks there is a considerable tendency to favor the electric wagon over the gasoline machine for this reason. It is believed that the business of 1910 in this line will be very much larger than that of 1909. In pleasure vehicles the beauties of the "electrics" in their own field are widely understood, and here, too, the manufacturers expect that 1910 will be their banner year. In the automobile industry, as a whole, the electric machines generally have a higher standing than ever before. No longer is this type of car the Cinderella of the automobile family; it seems almost certain of a decided impetus in this new year, and the seller of electricity should be alert to his opportunities.

WIRELESS TELEGRAPHY AND TELEPHONY.

Although no very sensational development has occurred either in wireless telegraphy or telephony during the past year, yet there has been very appreciable advance in both. It will be remembered that public attention was forcibly directed to the value and utility of wireless communication between passenger steamers by the circumstances connected with the loss of the *Republic* in January of last year. A wireless general call for assistance from the heavily injured *Republic* was detected by the *Baltic*, then some 70 miles to the westward, which vessel succeeded in reaching the *Republic* and saving the passengers and crew, numbering in all some 1600 persons, before the injured vessel sank in deep water. There would probably have been much loss of life if the *Republic* had not been equipped wirelessly. This event has had a marked effect upon the use of wireless telegraphy by ocean passenger ships. Nearly all the large Atlantic liners have been equipped with the apparatus. Out of 282 steamships of all kinds carrying steerage passengers to or from the United States during the first half of 1909, 143 are stated to have been wirelessly equipped, while of 167 prominent coastwise vessels, 97 were so equipped. In the navy records there are now nearly 1000 specified wireless telegraph shore stations or equipped vessels, exclusive of numerous warships.

In receiving instruments or wave-detectors, solid rectifiers have come into very extended use during the year. In fact, it is now common to use two such receivers, one of perikon, for long-distance most sensitive work, and the other, say, of carborundum, of lesser sensitiveness, but greater stability for shorter range communication. Progress has also been announced in the direction of high-speed reception of wireless messages by the use of a string galvanometer and a photographic apparatus, whereby the rapid oscillations of the "string" enables the message to be recorded photographically on a moving strip of paper. In sending apparatus, improvement has been made both in oscillation frequency and in group frequency. As regards oscillation frequency, sustained oscillations have been successfully used at 75,000 or 100,000 cycles per second, both by means of specially designed alternators and of arc devices, whereby the sending antenna has been kept in full sustained oscillation instead of being allowed to give separate free oscillations by spark discharge. This has either greatly increased the radiation power, or has reduced the power needed to be supplied to an antenna in order to reach a distant station. As regards group frequency, when free oscillations or spark discharges are used, a distinct improvement has recently been made by exciting the antenna with a step-up transformer from a 500-cycle, alternator-current circuit, instead of from the usual 60-cycle circuit. The groups of oscillation-trains forming the signals then give rise to sounds in the receiving telephone

having a pitch of 500 cycles per second, to which the ear is much more acute than when the group-frequency is only 60 cycles per second. This increases the sensitiveness of the receiving system, and the range at which signals can be detected.

In European countries the industrial development of wireless telegraphy has crystallized fairly definitely, and is in the hands of a small number of companies; but up to the present time the business in this country has not correspondingly crystallized. In England, for example, all operators of wireless stations afloat or ashore are required to pass an examination in the elements of their duties, and to receive a certificate of capability. They are likewise to conform to an international code of regulations controlling the reception, transmission and delivery of such messages. Moreover, no person may set up a wireless station, even for experimental purposes, without a special license from the Government. These rules seem drastic and arbitrary from the standpoint of democracy, but they possess certain advantages. On the seaboard of this country there has been much trouble recently from amateur wireless stations, some few of which have considerable power, and interfere materially with the transmission of traffic. A commission has recently been ordered to investigate the matter, with a view to recommending a relief from the existing inconvenience. It would seem that the commission would have to recommend either the use of selective wireless apparatus not subject to interference, or legislation for policing wireless installations. Distinct progress has recently been made in long-distance wireless telegraphy by the use of relatively low frequencies and consequent long waves. It has been pointed out in a recent paper before the American Institute of Electrical Engineers that the effect of daylight absorption upon waves over 4 km in length was much less than upon shorter waves. Even with long waves, however, there is still apt to be considerably more absorption during daylight hours than during dark. It is stated that the greatest absorption is apt to occur between two stations when one is in sunlight while the other is still in darkness.

In the technology of wireless, steady development has taken place, although only the surface of the subject has yet been touched. Much work has been done in finding engineering formulas for the inductance of coils of given dimensions. Increased precision has attended the measurement of wave lengths and spark frequencies, while in a few cases the efficiency of sending stations has been measured. Curiously enough, the efficiency of the sending antenna has been found greater than was at first supposed, but the efficiency of the entire sending system less. Practicable formulas have also been arrived at for determining the two frequencies that are inevitably set up in the circuits of a sending antenna when primary and secondary paths are provided. By causing the primary current to be promptly suppressed in spark-discharge signaling, the radiation from the secondary circuit, including the antenna, is much improved. A considerable amount of research has recently been directed to find how a solid rectifier, such as carborundum, operates. It was at first thought that the action was of thermo-electric origin, but that suggestion seems now discredited. The latest hypothesis is that an electrochemically reversible film occurs on the substance of the rectifier at the point of electrode contact, but the matter has not yet been cleared up. Most rectifying substances are crystalline in structure, but the fact that a few are amorphous indicates that crystalline structure is not the underlying cause of the action. As to the commercial status of wireless telephony, this appears to be largely confined to the sale of stock.

ELECTRIC HEATING.

In the field of electrically heated devices, undoubtedly the most notable development of the year has been the use of nickel-chromium alloys, which make it possible so to shorten the wire or ribbon used as a resistor in electrically heated appliances as to simplify greatly their construction. Although the specific resistance of these nickel-chromium alloys is only a little greater than that of other alloys which have been used in heating appliances, the temperatures at which they can be worked is so much higher that the length of the conductor necessary is much reduced. Many of the difficulties in electrically heated appliances in years past have been caused by the long length of wire or ribbon which had to be employed. With these new alloys it is possible by virtue of the shortening of the length of the resistor to make the resistor in the shape of a flat stamped ribbon which can be brought intimately in contact with the surfaces to be heated. The successful construction of electrically heated appliances nowadays involves a careful consideration of thermal principles which formerly were largely neglected. That is, the design must be such that the heat is conducted away from the resistor into any part to be heated with as little resistance to the transfer of heat as possible. Insulators of electricity are usually insulators of heat also, so that the thicker the insulation, the lower the heat conductivity; moreover, the more the heat is confined to the conductor, the greater is the danger of its destruction. With short lengths of flat ribbon, thin insulation, which is both high in electric insulating qualities and low in heat insulating qualities, is more feasible of use than in the case of most of the older types of construction. The temperature per square inch which can be safely obtained with nickel-chromium heating elements which have been, and are being, rapidly developed is considerably higher than a year ago.

One interesting tendency as regards the details of apparatus is that of employing radiant heat for broiling and toasting, where, before, contact of surfaces or conducted heat was depended upon. Apparatus on the fireless cooker principle of thorough heat insulation with electricity as a heating medium seemed to have great promise a year ago and was looked forward to by the central-station man with considerable eagerness on the theory that it would so reduce the maximum demand of baking and roasting apparatus as to render it feasible to perform these operations with a low investment in distributing apparatus per consumer and, hence, at a price attractive to the consumer. The hopes of a year ago, however, do not seem to have been realized as yet. Possibly this may be due to the difficulty of producing a cheap and reliable thermostat for cutting off the current when a certain interior temperature is reached. Such a thermostat is a necessity in an apparatus in which the heat is so thoroughly confined as it is in an appliance built on the principle of the fireless cooker. One plan advanced recently for reducing the maximum demand required for water heating involves the use of a certain amount of electrical

power, continuously, 24 hours per day, the heat so generated being stored in the water, metal and steam in the apparatus so as to permit a considerable quantity to be drawn at once. With this system in general use, the central station would have practically the ideal load factor of 100 per cent.

DEVELOPMENTS IN ELECTRICAL MACHINERY.

Much attention has been directed during the past year to the electric driving of rolling mills, the successful operation of the equipment at Gary, Ind., having attracted much attention. Not the least important element in the Gary installation is the storage battery, which acts to minimize the load fluctuation on the alternating-current generators. It is not remarkable, therefore, that the link connecting the alternating-current system to the direct-current storage battery has been discussed in detail. This link is formed by split-pole converters, the characteristics of which have been noted repeatedly in our columns. The variable transformation ratio obtained with the split-pole converter is dependent upon changes in the relative magnetic strengths of certain pole sections, for the excitation of which direct current is required. Evidently fluctuations in the alternating-current load would not have a sufficient effect upon the battery unless provision were made for changing the excitation of the pole sections with each fluctuation in the load. Thus an important feature of the converter installation is the exciter, the delivered direct voltage of which depends upon the load on the alternating-current system. The exciter is a special direct-current generator, the magnetic field of which is produced by the resultant opposing action of a constant m.m.f., and a m.m.f. varying with the alternating-current load. The latter m.m.f. is the result of a polyphase revolving field held stationary in space by synchronously revolving in the opposite direction the armature in which the field is produced. The polyphase revolving field—or, rather, m.m.f.—is obtained from series transformers connected in the alternating-current load circuit, so that fluctuations in the load current above or below the mean value determined by the constant m.m.f. cause the battery to be charged or discharged at any desired rate; the battery load may even be more than sufficient to represent the load fluctuations if the adjustments are arranged for this purpose. This exciter, which possesses characteristics found in both direct-current and alternating-current machinery, and a few distinctly its own, is one of the most interesting machines developed in recent years, and to it as much as to the split-pole converters must be given credit for the successful results obtained at Gary.

An application of the split-pole feature to converters for changing the e.m.f. of a direct-current system from one value to another in a single armature was noted in our columns recently. Each field-pole on the machine is divided into two parts, and the armature is provided with double the usual number of brushes. The extra brushes are placed on the commutator between the usual full-voltage brushes, and the e.m.f. at the added brushes divides the total e.m.f. between the main brushes into parts bearing a direct ratio to the field strengths of the parts into which the main poles have been divided. Sparking does not take place at the added brushes because they are placed on the commutator where the voltage between adjacent segments has zero value, although it has a positive value on both sides of the brush position. The split-pole, direct-current converter without provision for changing its field strength delivers a practically constant secondary e.m.f. at all loads, but it can be equipped with series coils so adjusted that it delivers a constant secondary current throughout a considerable range of voltage. It has been applied for varying the voltage delivered to traction motors from a constant-voltage battery, and has resulted in a very high energy efficiency for the whole installation when used in this connection.

An interesting machine that can be looked upon more as an application of well-known induction motor principles rather than the development of a new type is found in the so-called "spinner" motor. This machine has been discussed in our columns, but has not been placed on the market in this country. It consists of a stator of the usual form, a squirrel-cage rotor of the well-known shape, and a "spinner" of annular section which revolves in the enlarged air-gap between the stator and the rotor. The spinner is built up with a laminated steel core, on the external surface of which is placed a squirrel-cage winding which acts as the secondary for the stator winding, and on the inner surface of which are placed three-phase windings, which act as primary to the squirrel-cage secondary on the rotor. Arrangements are made for clamping the spinner stationary when desired, in which case the stator is idle and the rotor has a speed determined by the number of poles on the inner winding of the spinner. When the stator winding is excited, the spinner revolves at a speed set by the number of stator poles. This speed may be either positive or negative with reference to the direction of motion of the rotor, and thus may either increase or decrease the resultant speed of the rotor. By a suitable selection of the number of poles, the motor can operate efficiently at any one of three speeds, and is said to be suitable for adjustable-speed service or where the motor must start from rest under a heavy torque.

ELECTROTECHNICAL PROGRESS.

In many directions steady electrotechnical advance has been made during the past year. From a practical standpoint, higher voltages and frequencies have been reached in industrial work. In energy transmission by electricity the alternating e.m.f. of 110,000 volts, at the generating end of the line, has entered into steady operation, and has graduated from its experimental stage. This represents over 150,000 volts of maximum cyclic voltage. Along with this advance in line pressure has necessarily been associated technical advance in the design, use and control of high electric pressures, so that 200,000 volts effective is becoming a familiar dielectric-test pressure in factories and laboratories. When it is remembered that 20 years ago 6000 volts was regarded as a very high effective alternating pressure, the great advance in knowledge, in the discovery of insulating materials and of insulating processes, will be apparent. In regard to high frequency, alternators rated at over 1 kw have been constructed and tested capable of maintaining a frequency of 100,000 cycles per second. Although the application of such alternators is limited at present to the field of wireless transmission, yet this electromechanical achievement has marked a distinct step in advance. Marked progress has also been made electrotechnically last year in alternating-current

railroad operation, notably in the case of the Cascade tunnel three-phase installation, recently the subject of an A. I. E. E. paper by Dr. Cary T. Hutchinson. It would seem to be only a question of decades as to the final electrification of all railroads. Those entering crowded cities, or traversing water-power regions, may be expected to undergo the transformation sooner, and those near coal but far from falling water, later. In general, it may be said that heavy electrical egineering, including electric traction, transmission and furnace work, has made appreciable advance during the year, both in the scale of new operations and in the dimensions of new elements.

Electric lighting has seen marked advance in the use of tungsten incandescent lamps and of flaming arc lamps. That is, efficient electric illuminators have won increased recognition. In part, this has been due to the public demand for stronger and more efficient lamps, but it is also attributable in considerable measure to technical knowledge and selection. Illuminating engineering, both as an art and as a profession, has made evident progress. The advice of an illuminating engineer is being taken more frequently in regard to the lighting of important buildings, streets and parkways, with a corresponding manifest improvement in the effectiveness and good taste of the illumination displayed. In regard to wire telegraphy, very little advance has been made. It marks time merely. In fact, in some directions it appears to have retrogressed. The most hopeful telegraphic event of the year has been the merging of a large telegraphic and telephonic administration, from which good results for at least the former branch may be hoped for in the future. In the direction of wire telephony, advance has been made in the number and distribution of telephone substations, including subscriber's lines and general equipment. Technically, but little noticeable progress has been made. The general spread of underground lines, in exchange for overhead lines, tends to absorb the technical progress of telephony. That is, the constant tendency to make telephonic service less satisfactory by reason of increased underground cable conductors has to be offset by general improvements in apparatus and plant in order to maintain the general standard. Moreover, the extension and progress of heavy electrical engineering tends to hamper and impede wire telegraphy and telephony, their weaker brethren in light electrical engineering. The ubiquity of the trolley car, the ramification of the monophase railroad, the extension of the high-tension transmission line, all tend to reduce quadruplex to duplex, duplex to simplex, high-speed telegraphy to low-speed telegraphy, clear and good articulation to telephonic mumbling in a roar. Each year the telephone engineer is besieged a little more closely in running trunk lines, so that, in time, it may be necessary to secure special signaling-line rights of way in order to give satisfactory long-distance telegraph and telephone service. For these reasons, the maintenance of even the *status quo* in wire telegraphy and telephony involves actual technical progress.

In regard to working units in electrotechnical measurements the agreement for the adoption of the international candle, at the value of the bougie decimale, between England, France and America, has been a splendid achievement and the best advance in this direction for many years. These three countries now have one and the same unit of photometric intensity, in addition to the same practical electric units of the ohm, volt, ampere, series. The theory of electrotechnics has made steady although not remarkable advance during the past year. The ordinary phenomena of alternating-current circuits are now so fully dealt with in text books that they have ceased to excite particular interest. Attention has centered upon more complex and recondite alternating-current phenomena. Noteworthy advance has been made in the electrotechnical applications of hyperbolic functions, and of electromagnetic apparatus to the automatic solution of algebraic equations. In the electronic theory distinct advance has been made towards a theory of gravitation, a theory of matter, and a theory of non-Newtonian dynamics. All these are in their speculative stage at present, but developments may be looked for at any moment. In geomagnetics, the year has been noteworthy by seeing the first cruise of the specially constructed non-magnetic schooner *Carnegie* in service for observation of magnetic declination, dip and intensity in different regions of the ocean. Solar magnetics have also received marked impetus recently from spectroscopic observations of disturbances on the surface of the sun.

The sociological influence of electrotechnics has been manifested not merely in increased application of electricity to the service of the community, or in increased familiarity on the part of the public with electricity and its utilization, but from the increasing influence which electrical engineering is exerting, in common with other branches of engineering, toward the conservation of national resources. The electrical engineer knows the economic value of solar energy, and realizes the potential economic value of waterfalls. He also knows that deforestation is another name for the destruction of hydraulic natural resources, by causing the water to disappear. The influence of electrotechnics is thus constantly acting in favor of forest maintenance. An appreciable share in the recent national movement toward forest conservation is therefore attributable to electrotechnical progress and electrotechnologists. The year has been rendered noteworthy by the fact that, according to recently published statistics, for the first time in many years, there has been a distinct falling off in the registration of engineering students throughout the country, taking all the colleges and technical institutes collectively. This is by no means necessarily to be regretted, if the statistics are correct. In the first place, there has been a general rise in the standards of entry, and of graduation in engineering college training. Secondly, during the past 15 years the rate of increase in engineering students has been far in excess of the increase in population or of the increase in students of other professions; so that, for both reasons, a check upon the rate of increase is not unwholesome.

PRIME MOVERS.

In the general field of central-power stations there has been during the past year little of pyrotechnic character in the progress on lines of development relating to sources of energy and types of prime movers. Attention continues to be focused on the making of small economies, of stopping the manifold small leaks by means of which heat energy escapes from the power house as heat rather than being transformed into some other desired useful product. Coal and fuel oil continue to divide the field according to price and local conditions. Coal remains predominant, as it doubtless will, at least so long as the

existing relations between the cost of the two types of fuel remain approximately as at present. So far as the fuel costs of a pound of steam are concerned, the two fuels are substantially on an equality when the price of coal per long ton is between 4 and 4.5 times that of oil per standard barrel of 42 gal. In only a small section of the country, notably on the Pacific Coast, does this relation give a distinct advantage to oil. The engineering problems involved in the economic and effective combustion of oil for central power stations have reached fairly satisfactory solution, and the question of its use in any given case has become one of economics rather than of engineering. Its general advantages, including ease of handling, reduction of fireroom force, cleanliness, absence of ashes, regularity of firing control of combustion, etc., are all too well understood to require extended notice. Where the use of oil as fuel is well understood as an engineering problem, its use would undoubtedly be preferred by reason of its various advantages, even at a slight disadvantages on the basis of cost alone. One point which has sometimes escaped notice in the comparison of boiler efficiency with coal and oil fuel may be here mentioned. In the case of a boiler-fired coke, the entire product in terms of steam is, in a sense, a net product. In the case of the boiler fired with oil, this is not the case. A part of the steam generated must be used either directly or indirectly for atomizing the oil, such part varying from 3 per cent to 5 per cent in usual cases. The gross output of steam and any efficiency based thereon must, therefore, be reduced by such amount before the figures will represent the net output or efficiency of the boiler.

It still remains the fact that the most notable preventable losses in modern power plants are usually to be found in the boiler-room. Better attention to the conditions of combustion, to air supply and distribution of draft, to boiler setting and the use of heat-insulating materials, all these point the way to better conditions in boiler-room practice. A hopeful sign is the use to an increasing degree of flue-gas analysis, either by some form of recording device or by the common Orsat apparatus. The use of such instruments is increasing in marked degree in large power plants and central stations, and their indications are taken as the basis of an intelligent adjustment of air supply and distribution, resulting in a marked increase in the percentage of CO_2 in the flue gases, and in a corresponding improvement in the economic conditions of boiler working. The use of a complete lined boiler furnace seems to be attracting increased attention, and the year has witnessed a large increase in this application. With this arrangement the tubes or heating surfaces of the boiler are entirely protected from the immediate action of the flame in the furnace, with the result that the combustion can be made more perfect, smoke formation with proper design otherwise can be decreased and the general economic conditions of the boiler improved so far as these depend on the efficiency of combustion. The products of this combustion are then led by appropriate baffling into contact with the heating surface of the boiler, and in the same general manner as with the common type of furnace. The underlying principles of this arrangement involve the complete separation of the furnace as a place for the combustion of the fuel, the products of such combustion being then used in the same general manner as at present. This suggestion is full of significance and deserves careful study with reference to its full commercial value. Results reported by Professor Nicholson, of Manchester, England, have served to draw the attention of engineers in the most emphatic manner to the possibilities of an increase in the coefficient of heat transmission through boiler-heating surfaces by an increased velocity of flow of hot gas over such surfaces, resulting in a large increase of capacity per square foot of actual heating surfaces. Professor Nicholson, starting from the assumption of the existence of a more or less stagnant film of gas next to the metal of the heating surface, concludes that by employing very high velocities, such film may be brushed off and its insulating effect eliminated. Remarkable results showing an evaporation of some 8 or 10 times normal amounts are cited in support of these views, the drafts employed being represented by from 10 in. to 20 in. of water. These views have met with some criticism, and it yet remains to determine by further trial and adaptation to working conditions to what extent the way may be thus opened up for an increase in boiler output without loss of economy or undue increase in upkeep charges. In any event, the results reported by Professor Nicholson have been perhaps the most important single event of the year in reference to boiler design and operative practice, and engineers will await with the keenest interest further reports regarding the practicable commercial outcome of these suggestions.

In the field of prime movers, all leading types seem to have fared well in the year's business, including reciprocating steam engines, steam turbines, gas engines, and liquid-fuel motors to some extent, thus showing that special service, local, business and other conditions enter largely into the type adopted in any given case. The general hold of the steam turbine for electrical central-station drive is, however, still more definitely confirmed by the past years of experience—not by the demonstration of superior thermal economy, but rather by continued demonstration of special adaptation to the conditions of central-station drive, especially when running in parallel with other prime movers and particularly when connected to an extended network of electrical distribution. Combinations of low-pressure turbines and reciprocating engines have also attracted increased attention, and several such plants are now operating at a greatly improved over-all economy. While this arrangement is entirely feasible for new installations, it has thus far for the most part been restricted to existing plants where increased capacity is desired, and where the existing reciprocating engines may be operated non-condensing for exhaust to the newly installed low-pressure turbine. The usual proportion of capacity in the two types of prime movers should be about equal, since it is a simple matter of thermodynamics to show that there is about the same available energy in steam operated on the Rankine cycle between limits of some 17 lb. or 18 lb. pressure to ½ lb. on the one hand, and about 175 lb to 17 lb. or 18 lb. on the other. This forms an attractive and apparently effective method of increasing output and of improving economy, and deserves careful consideration at the hands of all central-station engineers.

Progress in gas engines and gas-producer plants has been along conservative lines. Several large stations have reported good results during the year, some new installations have gone

in, and the gas engine and producer-gas plant must be recognized as a type of station equipment acceptable and available where local or special conditions may be such as to permit utilization of the advantages peculiar to such type. The troubles and limitations of such equipment are coming to be of an operative and detailed character, and are presumably only such as will ultimately yield to further study and applied experience. Producer-gas plants for oil fuel and furnishing a hp-hour for 1 lb. of crude oil, or less, have been reported from the Pacific Coast, and have attracted marked interest with reference to their adaptation to plants of relatively small size, appropriate for isolated stations, for pumping, mining, central stations of small towns, etc. An interesting report has come from Germany of a gas producer for especially low and cheap-grade fuel, such as coal dust, coke, chips and refuse, etc. The first cost is somewhat greater than for high-grade fuel, but tests have shown the very gratifying consumption of about 1 lb. of fuel per hp-hour, which, with the low cost of the fuel, reduces the fuel cost per unit of work to a very low figure.

Regarding prime movers using oil direct, the Diesel and Brayton types continue to attract attention, especially in Europe. For the former a record consumption of 0.66 lb. crude oil per kw-hour has been reported. Results of tests extending over some length of time show, furthemore, that in actual service the economy of the Diesel engine may be expected to approach to within 12 per cent to 15 per cent of its guaranteed economy under test conditions. This compares favorably with the corresponding figures for steam engines and shows that this type of prime mover represents a very high order of thermal economy. During the past few years, the world over, several plants from moderate to large size have been equipped with oil engines of one type or another, and the possibilities of this form of prime mover can no longer be overlooked. In the United States the chief difficulties have been in the high price of such forms of prime movers, and the liability to breakage or derangement due to special features of their mode of operation. In one make of engine operative troubles have been substantially overcome by giving excessive size and strength to the parts subjected to serious stress, but at the expense of an alarming cost per unit of rated output. The development of a satisfactory, dependable, economical internal-combustion engine of not too high first cost, using crude-oil fuel, is still one of the outlying problems, especially in sizes which would have special significance for power-plant service, but, as with other life problems, it seems reasonable to expect a satisfactory solution after further detailed study and the application of accumulated experience.

INDUSTRIAL ELECTRIC POWER.

The present situation in the field of electric power supply and application exhibits conditions more favorable to profitable development than have ever before confronted the industrial world. For many years the success of the motor drive has been continuously demonstrated in a constantly widening area of service. From small and experimental beginnings it has entered a field of almost unlimited scope, and the growth of service which successful experience has created, combined with recent acute study of design, construction and operation, indicates as never before the permanence and potentiality of electric power as concomitant of modern progress. Intelligent engineering must always be applied to electric motor problems by the plant owner and the central station before complete success can be assured. Given this, the chances that the motor drive once established will ever be repudiated are infinitesimal. We cannot recall a single instance where a well-designed and carefully installed motor equipment has been replaced by any other form of motive power. It is the universal experience, from electrified steam railroad to the astronomical laboratory, that one motor installation leads to another. Considering the hasty manner in which the motor drive is often applied, the success which practically every case illustrates augurs remarkably well for the future of skillfully planned developments. The tools are at hand and the field of work awaits both intensive and extensive cultivation by the manufacturer and he central station. Looking back upon the present per capita motor-service earnings, the progressive central-station manager will marvel 10 years hence that so little attention was paid to the marketing of off-peak business; that it took so long in the older sections of the country to realize the profits of electric vehicle charging at night; and that so much energy was expended in adding to the commercial lighting peak when a large percentage of the plant capacity remained idle for 20 hours per day.

The intimate relation of the central station to the supply of motor service justifies the most acute attention to this branch of public-utility operation. Far-sighted managers are now proceeding to secure motor business on the basis of prices which permit close competition with isolated plant production. Not a few companies now recognize that power can be sold off the peak at a figure very considerably below that which would be profitable when the station capacity is demanded by lighting consumers. Since fixed charges remain practically the same regardless of whether the equipment is busy or idle, and since the labor cost per kw-hour is only slightly increased by the operation of machinery that would otherwise be held in reserve during the day, a price for off-peak power which will cover the cost of fuel and supplies, allow something for labor and distribution, and show a small unit profit, can usually be made the basis of a very successful motor business, frequently underselling a well-operated isolated plant. Notable work of this kind has been done in Muncie, Ind.; Hartford, Conn.; Westerly, R. I.; Montreal, Can.; Barre, Vt., and other localities where the industrial conditions are flexible or diversified. While hydro-electric power is often useful in handling non-peak business, it is entirely feasible for a steam-driven central station occupying a strategic position in a manufacturing community to cultivate motor business during the hours when the demands upon its unused capacity are negligible. A most important benefit of off-peak business is found in its improvement of the station and machine load factor, leading in almost every case to a reduction in the unit cost of energy, regardless of the hour at which it is produced.

Two specially attractive sources of off-peak business are municipal or industrial pumping and artificial refrigeration. In the former case the demand upon the station may vary considerably from month to month, but the work almost always can be accomplished at times when the maximum output of the plant is not demanded. For considerable periods the load is

likely to be reasonably constant, and the facility with which pumping installations can be shut down when operated in connection with suitable tanks or reservoirs lends attraction to this class of service. A new departure in central-station pumping has recently been placed in operation at Lynn, Mass., with special adaptability to the handling of small quantities of sewage at scattered points. Beneath an important street in the business center there has been installed a chamber equipped with motor-driven centrifugal pumps automatically controlled by floats. A difference in level between the main and the branch sewer necessitates the pumping, while the work to be done is too small to support a station with attendance. Nothing prevents equipment of this character being operated off the peak if desired, but with a number of installations the intermittent service should enable the work to be handled with minimum station capacity. The advantages of a refrigeration load are still greater. Here the occurrence of the cooling peak at the season of least maximum load upon the station is most attractive.

Recent active work along this line in Philadelphia and elsewhere in connection with restaurants, ice-cream parlors, bakeries, butcher shops and large residences shows good profits to the central station at costs which reduce former expenses on the customers' premises. In one produce house the refrigerating plant will pay for itself in 4½ years, the cost of operation being only about one-third of ice purchase. The cleanliness and saving in space in applying electric refrigeration are important features where rentals are high or quarters constricted. In the general industrial field the conspicuous success of the electric motor in steel-mill service sets a new standard of attainment in the application of the electric drive under the most severe conditions to be found in modern industry. Probably no industrial application of electricity in recent years has exceeded in interest the enormous and varied installation of the Indiana Steel Company at Gary. Here the electric motor problems were worked out upon a clear slate, and the results indicate that the steam engine is doomed as a machine drive in the steel industry. By the use of the flywheel and controlling apparatus of the most flexible and comprehensive type, even the difficult problem of driving rolling-mill passes by a 6000-hp motor has been solved. In the steel mill, interruptions are intolerable. The absence of any noteworthy modifications in the Gary equipment after months of service under such conditions indicates something of the future of electric power in steel manufacturing, when the electrical engineer is given a free hand in the selection of equipment. In less striking but none the less effective applications, the electric motor is conquering the motive power situation in every nook and corner of the industrial world.

ILLUMINATING ENGINEERING.

It seems an opportune time to review not only the progress of the past year in illuminating engineering, but also the progress made in the four years that have now elapsed since the organization of the Illuminating Engineering Society in January, 1906. In 1905 the sentiment that had been gradually gaining strength among electrical men as to the necessity for more thought in the designing of artificial lighting installations, resulted in the formation of the Illuminating Engineering Society, which took in not only electrical men, but those interested in other branches of the work. At that time there was but little general knowledge as to the principles of illuminating engineering. Its study had been confined mainly to a few specialists whose suggestions were too often fruitless because of a lack of appreciation by electricians and light users. In a general way, those who had given a little thought to the matter of efficient and comfortable illumination appreciated the bad effect of exposed lamps of high intrinsic brilliancy which intrude themselves in the range of vision and reduce the comfort and efficiency of any system of lighting. There was also a dawning knowledge of the effect of reflectors and reflecting surfaces, but there was little definite information on record. During the short period of its existence, the society has brought together in its *Transactions* a volume of valuable information along theoretical and practical lines, which has more than fulfilled the hopes of its founders as to the usefulness of such a body. Illuminating engineering deals partly with physics and partly with physiology and psychology. It is along the lines of physics, where definite measurements can be made, that the largest amount of practical information has been brought out. The physiological questions involving color and intensity are yet subject to considerable study before much quantitative information of practical application in illuminating engineering will be forthcoming. The artistic or æsthetic side has also justly received considerable attention in the *Transactions* of the society. As before stated, however, the largest increase of practical knowledge has been along the line of measurements and methods of calculation.

Photometers for the measurement of the actual illumination obtained have undergone much improvement, both in accuracy and facility of working. As to methods of preliminary calculation, it is interesting to note the rapid evolution through which practice has been going in four years. The old method, and one which is still very useful when applied in the light of present knowledge, is to allow a certain number of rated candle-power or watts per square foot with given types of lamps. As first applied, this method was extremely crude, because it did not take into account the efficiency of utilization of the light or the actual illumination intensity wanted. As an improvement on this method some early attempts were made to figure the illumination obtained, in foot-candles, by taking the rated candle-power of the bare lamp used without any regard to the direction in which this rated candle-power would be given off. The fallacy of this method of calculation soon became apparent, however, after a study of the effect of various reflectors and glassware had revealed the great differences in light distribution, with different appliances for directing and reflecting the light. This led up to what is now commonly known as the "point by point" method of calculation in which photometric curves of light distribution about the source of the light used are taken as a basis for calculating the illumination given on a horizontal plane underneath the source of light. If several sources are used, adding together the illumination from the various sources was assumed to give approximately the total illumination. It was, of course, appreciated that reflection from ceiling and walls in the lighting of interiors played a very important part, but it is only within the past two years

that it has been convincingly shown to practical men by actual measurements what a great effect changes in the ceiling and wall colors have on the illumination.

As the point-by-point method of calculation involves a considerable expenditure of time, it was then suggested that labor could be saved by figuring the flux of light given out by the lamps and then considering the flux falling on the working plane; by dividing by the area of the plane, the flux per unit of area would thus be obtained. This, according to the common present system of American nomenclature, would give the average intensity in foot-candles. This, of course, also would ignore the effect of the reflection from walls and ceiling, as did the point-by-point method. The principal difficulty with this method has been in determining what portion of the light strikes the working plane. Those who proposed the method of applying this plan of calculation assumed arbitrarily that the light given out below certain angles from a symmetrical source of light would strike the working plane. Another practical difficulty of this method, as with the point-by-point method, is its neglect of the great effect of reflection from ceiling and walls, which completely upsets all methods of calculation in which the light received directly from the lamps alone is estimated. A corollary to the flux of light method has been proposed, namely, calculation of the amount of light absorbed by ceiling, floors and walls, the difference between the light absorbed and the light given out by the lamps being the total flux on the working plane. The difficulty which practical men find with this method, as with the flux of light method, lies in determining the amount of light actually falling on the various walls or absorbing surfaces in the room, and also in estimating the probable absorption of these surfaces. The result of the situation so far is that many practical engineers pay little attention to these systematic methods, but rely on more or less empirical methods based on data obtained from actual tests; and it is to these that the great value of the investigations published in the *Transactions* of the Illuminating Engineering Society and elsewhere in the past four years is most apparent.

The tests on actual installations, both interior and exterior, which have been made public and which are of value in making up constants for illumination calculations under various conditions, now run into the hundreds and the good work still continues. The effect of dirt and other deterioration of illuminants in practice has always been more or less appreciated, but within the past year an increasing amount of study has been given to the subject and more information is available than formerly. With the general increase in the efficiency of electric illuminants, which has usually gone hand in hand with an increase in the intrinsic brilliancy, there is a notable tendency toward a return to older methods of indirect lighting in some of its more efficient forms. Several companies have brought out or are experimenting with indirect lighting of the type in which lamps are hung from central areas in the ceiling and the light directed first to the ceiling and thence by reflection from the light-colored ceiling to the working plane. The elements which go to make up high efficiency in both direct and indirect lighting systems have been more carefully studied recently than ever before. The importance of losses caused by absorption by dark-colored walls where considerable light is directed horizontally, is more appreciated than ever before, and is now recognized as one of the principal sources of loss in inefficient direct and indirect systems. A few years ago it was considered difficult to light efficiently a high interior because of the relatively great distance of the lamps from the working plane. It is now known that by proper use of reflectors or reflecting surfaces large interiors can be lighted from great heights with a degree of efficiency that compares favorably with interiors where the lamps are placed low. The recognition of this consideration is of great practical importance, because it is frequently possible to place lamps high up out of range of ordinary vision and at the same time get reasonably efficient results. Reflector design has been reduced to a scientific basis, instead of depending on the hit-and-miss methods of a few years ago.

THE PRESENT STATUS OF PHOTOMETRY.

Photometry as an exact science is of comparatively recent origin, and its methods, its standards and its terminology have but recently been given the careful, discriminating consideration that has been accorded many other branches of physical science. This slow development from the very early beginning has resulted partly from the complex nature of the science, involving, as it does, physiological, and even psychological, elements in addition to the more peculiarly physical ones; and partly, no doubt, from the fact that, notwithstanding its inherent complexity, it has usually been considered, on account of its practical utility, as befitting the factory rather more than the laboratory. It has been touched now and then, on one side or another, by the work of some master and this touch has always served to elevate and develop it. But only in recent years has its development been systematic and definite, which is ascribable in no small degree to the establishment of our great national standardizing and testing laboratories. The past year has witnessed the adoption by England, France and the United States of a common unit of candle-power, for which the name *international candle* has been proposed. Although this unit has not been adopted by Germany, its ratio to the hefner unit is a simple known quantity which has been universally accepted. The agreement upon a common unit of candle-power in terms of which all luminous sources shall be expressed both in this country and to a great extent abroad, is of more significance than the development of a primary standard which shall excel all those in use at the present time, however desirable the latter may be. There is now no reason why inaccurate photometry should be ascribed to indefinite standards.

A precise nomenclature is a necessary prerequisite to an exact science. Unfortunately, the nomenclature of photometry at present leaves much to be desired, but it is hoped that the International Committee on Nomenclature and Standards of the Illuminating Engineering Society may be able to accomplish in this respect as prompt and definite results as those which crowned their efforts in behalf of the international unit of candle-power. International agreement upon some practical exact system of definitions and terminology would do much to clear away the haze that at present pervades the science. Aside from the important conventions in regard to nomenclature and standards, the science itself has shown marked development. It is true that the inverse-square law and the cosine law, among the oldest heritages of the science, still underlie most photometric methods and measurements. But to-day these laws are

used with discrimination. Their value and their limitations are better known, and, moreover, are usually taken into consideration in practical measurements. The value of the *total flux* of light from a source is now recognized and various instruments exist which give in a single reading this quantity, or its somewhat equivalent, but less desirable substitute, the *mean spherical candle-power*. Although it must be admitted that these instruments have not yet reached the desired degree of perfection, the resultant errors, when a method of substitution is employed, are usually within the limits required in industrial practice. It is hoped that the evaluation of illuminants in total lumens may be more general in the future than it has been in the past.

The war among photometer screens or sight-boxes is still being waged, and no definite, satisfactory understanding has been reached. A careful, precise study of these instruments under well-controlled comparable conditions with carefully trained, unbiased observers would be of great value. Such an investigation would quite probably show that with two steady sources of approximately the same color, a well-trained, but unbiased observer would obtain results of highest accuracy with a form of contrast photometer somewhat like that of the Lummer-Brodhun type. The conclusion when the sources are unsteady, or the quality of their light markedly different, or the continuance of observation long, is not so easy to predict. In particular, as the difference in color between the two sources to be compared becomes marked, the difficulties of measurement with almost all types of photometers increase greatly. The flicker photometer has been exploited as the solution of the problem of heterochromatic photometry, but there is still an ominous absence of accord on the practical utility and scientific value of this instrument. The phenomena of flicker photometry are so complicated that there appears to be need of further investigation before a correct estimate of the value and peculiar merit of the flicker photometer can be reached. One of the live problems in photometry at the present day is this question of the proper evaluation of luminous sources having different spectral compositions. As in the case of the unit of candle-power, it would seem that here also it is more important that, if possible, methods of heterochromatic photometry be standardized, rather than that such a convention should be withheld until a satisfactory instrument is found. After all, the average eye is the final authority on the relative intensities of a reddish and a bluish light; and if the average judgment of a number of competent observers of normal vision is recorded by means of a suitable color screen or in some equivalent way, and if this record is placed in the custody of our national laboratories, there would be little reason why such comparisons as between a 1¼-watt per candle tungsten lamp and a 4-watt per candle carbon lamp should not be made with the same uniformity of result as that now obtained in comparing sources of the same color. This is a matter which, it is hoped, the Illuminating Engineering Society will push forward with all dispatch.

In reviewing photometric methods and apparatus mention should be made of the rotating sectored disk. Talbot's law has been found by various investigators to be entirely verified for such ranges, and to well within such limits of accuracy, as are required in ordinary photometric measurements. Rotating sectored disks, which constitute one of the most convenient and useful helps in photometric measurement, can, therefore, be used with entire confidence. Photometry, or the measurement of light, embraces in its broadest sense the so-called science of illuminometry, which is concerned particularly with the measurement of intensity of illumination. As a consequence of the recent notable development of illuminating engineering, stimulated and encouraged by the Illuminating Engineering Society of this country, and very recently given a fresh impetus abroad by the organization of a somewhat similar society in Great Britain, there have been many improvements in the instruments and methods used in making those measurements involved in the engineering art. It would be impossible, in a few words, to discuss the developments in this branch of photometry. Suffice it to say that the older and less exact instruments are rapidly being replaced by more exact ones, and that with the improvement in methods which are now being given careful and efficient study, the science of illuminating engineering is rapidly taking rank with the other great engineering sciences.

RURAL ELECTRICAL DISTRIBUTION

Whether he looks abroad or at home, the student of electrical progress must be struck by the fact that there has recently been a significant increase in the use of electricity on farms. Relatively, the amount of electrical energy thus consumed is still small, but the tendency shown not only by actual increase in the amount of electricity used in connection with agriculture, horticulture and dairying, but by the greater attention paid to the subject by farmers, market gardeners and stock men, as well as by manufacturing companies and central stations serving rural communities, is of real importance. In foreign countries, particularly in Germany and Italy, this subject has received careful attention for a number of years, although there, as here, rural applications of electricity have developed slowly until recently when an acceleration has been observed in the rate of progress. In Northern Italy there is a rather conspicuous example of the use of electrical energy in agriculture and in small rural communities. A network of distribution lines has been formed, owing to the interconnection of numerous and scattered sources of hydroelectric power. The Italian landed proprietors and small farmers have taken to the use of electric light and electric power from these water-power sources to an extent which makes one inclined to question our vaunted American enterprise, for there is nothing like it in this country. However, it is true, of course, that farms in Italy and indeed throughout all of Western Europe, are much smaller and more intensively cultivated than in the United States, and the conditions of life in rural communities are quite different, the isolated farmhouse with its surrounding outbuildings being the exception over there, where most of the agriculturists congregate in villages from which they operate their comparatively small holdings. German electrical manufacturers have studied this phase of electrical development with characteristic thoroughness and patience, as is indicated by an article printed elsewhere in this issue. With the exception of a portion of Northern Italy, Germany is to-day in advance of other nations in the application of electricity to agricultural operations. But in Germany, as in other parts of Europe, the development seems to have proceeded by the utilization of elec-

tricity from a central source of supply, rather than by the erection of isolated generating plants, which has been to some extent characteristic of the practice in this country. This difference is partly due, of course, to the larger average size of farms in the United States, making the cost of transmitting the electricity to the farm customer from the central station very often a serious problem. The literature on this subject which has appeared in Germany shows that applications of electricity for a number of varied uses on the farm have been carefully worked out. Rather sadly indicative of the more strenuous struggle for existence in Europe than in this country, the pictures illustrating electrical agricultural operations in the Fatherland show the comparatively large extent to which women are engaged in farming operations. Here we look on electricity as an agent to ameliorate the duties of women in the household; over there it appears that the introduction of electricity on the farm may lighten the labors of many a weary drudge proceeding stolidly about her out-door duties in short skirts, rough shoes and with shawl-covered head.

While the present tendency in this country in the utilization of electrical energy is rather toward the installation of private plants, there are a number of localities where electricity is sold to farmers by electric-service companies. This is particularly true in connection with water-power plants in Northern Colorado and in some places on the Pacific Coast. Often in semi-arid parts of the country the farmer or fruit grower uses electricity for pumping in connection with the distribution of water over his land for irrigation. There are also a few cases where steam-driven central stations in other parts of the country sell electricity to farmers, but these are not very numerous. Ordinarily the American farmer who uses electricity and is not within the area of a hydroelectric supply, generates his energy on his own premises. It is likely, however, that this is a condition that will not always obtain. As the advantages of the use of electricity from private plants are demonstrated, it is probable that to an increasing degree the central stations in small towns and villages surrounded by farms will push out more and more to secure this business, and it is possible that in years to come wires carrying electricity for light and power will be as common on rural highways as telephone wires are to-day.

One encouraging feature in the use of electricity on the American farm is the fact that not only are electrical manufacturers becoming interested in the subject, but the largest manufacturer of agricultural machinery in the country has also taken the matter up, particularly during the year 1909, and is now urging on the farmers of the country the advantages of electric light and power. This great concern, with its tens of thousands of salesmen, who reach nearly every hamlet in the country, is active in advocating the introduction of electrical apparatus among the farmers. The salesmen do not pretend to be electrical men, of course, but the literature they carry is so skilfully prepared that they can make estimates on almost any kind of installation desired by the farmer. Gas engines with producers or gasoline engines are usually installed, and these drive dynamos with a storage battery for reserve to supply the electricity needed for lighting the premises and often also for operating motors to drive the feed-cutters, corn-shellers, pumps, grain-conveyors and other machinery used at the farm headquarters. An interesting example of an installation of this kind is that on a large farm in De Kalb County, in Northern Illinois. Here there is a gas-producer installation, a gas engine and dynamo, and a pole line distributing electricity to about 150 lamps, some of which are tungsten. Electrical energy is also used to operate three motors, two used to drive various types of machinery in use about the farm headquarters and one installed in the house to operate a washing machine. There is also a storage battery of 52 cells, so that electricity is available at night or at other times when the plant may be shut down. The owner of this equipment has a private telephone line and a burglar-alarm service connecting his house with the tenant house on the premises and is, in fact, equipped with all the electrical conveniences which he could have in the city. Furthermore, he utilizes gas from his producer plant as fuel under the boiler of his steam-heating plant in the house. The owner proposes to introduce pneumatic cow-milking machines operated by electricity and feels that he is well repaid for the interest on his investment and the operating costs, the latter being small, by the advantages and conveniences of electricity. Anthracite pea coal is used to charge the producer and about two bushels a day are required. One hired man operates the plant and is enabled to give considerable time to his other duties.

It is by the increasing number of plants of this general description that the use of electricity on the American farm is principally characterized in the present stage of development. There seems to be no reason why the well-to-do farmer should not enjoy all the advantages of electricity which are open to his fellow citizen of equal means in the city. The use of the tungsten lamp, with its small current consumption, is particularly adapted to plants of this character. Some electrical manufacturers now make farm electric light sets complete, designed to operate at 30 volts (which is standard for car lighting) or 24 volts. The use of tungsten lamps makes these voltages practicable for lighting, and, of course, the number of cells in the storage battery is greatly decreased. These plants include gas engine, dynamo, switchboard, battery, wiring and, say, 50 lamps complete and are sold at a moderate price. Other manufacturers are bestirring themselves to interest the farmer in the installation of transformers reducing the voltage of high-tension transmission lines where available for use for the domestic and farm-headquarters work about the place. In Europe considerable work has been accomplished in adapting electric motors to the operation of agricultural machinery in the field, such as plows, cultivators, reapers, rakes, and the like, but not a great deal has been done in this country in this direction. For many years, also, experiments have been undertaken to stimulate the growth of plants directly by applications of electricity. One way of doing this is by the electrification of the atmosphere immediately above the growing plant, and on several farms in England, Germany and Holland elaborate networks of iron wires have been placed over fields to be treated for this purpose and with some positive results, as reported. Obviously, however, this method is only applicable to intensive farming, and, moreover, can at this stage be considered only in the light of an interesting experiment. In view of the acute agricultural labor situation, electric lighting for the farm has a doubly economic significance, for it enables the farm hands to accomplish more during working hours. The ordinary interiors of barns, corn cribs, sheds, etc., on farms are dark and gloomy,

but when electrically lighted, the output of labor performed in these buildings may be greatly increased. Furthermore, with proper methods of construction, the fire hazard is greatly reduced by the use of electric lighting, and this too is an item of importance to the farmer. Surveying the field generally at the beginning of 1910, it may be said that there is an encouraging indication of a decided increase in the use of electricity by well-to-do farmers in this country, and it is believed that the movement is bound to increase and spread so that no man can see the end from the beginning.

THE WATER-POWER SITUATION.

The past year has brought to the front with more significance than ever before, the subject of the unutilized water-powers of the country. The fact is that only recently have investors waked up to the value of hydraulic power in spite of the many lessons in effective and profitable energy transmission which we have had in the last decade. The steady increase in the demand of power, owing to the growth of manufacturing interests, and the certainty that the price of fuel is on the upgrade, have operated to bring hydraulic powers into prominence in the financial sense. If anything more were needed to accomplish this result, it may be found in the vigorous agitation on the part of some of the Government officials regarding the policy to be pursued with the water-powers on the public domain. A great power is a great natural resource, the proper development of which is of vital interest to the people of the community; and more and more the Government is inclined to consider such resources a trust for the benefit of the people rather than a present to be bestowed on the first promoter who lays claim to it. In order that a hydraulic privilege, or such a group of hydraulic privileges as exists in any particular State or region, may be developed so as to be of the greatest ultimate usefulness, they must be developed according to a coherent plan and in such way as to make the most of the available power. Within the last few years there has been a rapid tendency to change in practice regarding the extent to which a given privilege is to be developed. The older authorities held that a stream could justifiably be developed to a point approximating its average flow, the flow in June being often taken as a criterion. Of late there has been a decided inclination on the part of those installing plants to develop for a much larger proportion of the maximum power available in the stream and to depend on steam auxiliaries to make up the difference between the development and the periods of lesser flow. This is in a measure sound policy, the economics of each case depending on the cost of the development and the market conditions, and the tendency is one which must be reckoned with in considering the utilization of a group of powers.

To be entirely frank, however, we fear that the large developments sometimes made of late on comparatively modest privileges, have not been planned so much with strict reference to the engineering possibilities of the situation as to the financial status of the enterprise from the standpoint of the financier rather than the investor. No inconsiderable number of plants have been built, so far as outward appearances go, not so much with the view of obtaining the most economical development from the standpoint of returns, as for the purpose of floating the maximum amount of securities on a plant designed to make a large showing for the prospective bondholders rather than to produce and distribute energy at the minimum cost. This is a hard saying, but the list of such plants installed without proper economy in construction and for amounts of power much larger than the ordinary flow of the stream is sufficient to justify grave doubts as to their future. It would be well if prospective purchasers of bonds of water-power enterprises would see to it that the installation is made with a view to rigid economy in construction and operation, so that it shall bring the largest returns, not to the construction company doing the work, nor to the gentlemen who kindly consent to underwrite the securities, but to the ultimate owners of the property. Very few plants with respectable markets in sight will fail to pay returns when built for cash and operated for profit; but hydraulic developments at the present time are no place for high finance, and the sooner the public understands this and acts accordingly the better will its interest be served and the more wisely will the resources of the country be developed.

Some of the Government officials have raised a hue and cry over the alleged existence of a water-power trust. We have previously referred to this matter, but it is worthy of more than a casual comment, inasmuch as the allegations, if true, would indicate a state of affairs so grave as to call for the immediate and forceful intervention by the general Government and by the States. It is undoubtedly true, as has been pointed out in several Government reports, that a considerable proportion of the existing hydroelectric developments have common interests with the large electrical manufacturing companies. That these common interests are of a character to constitute practically common ownership is a matter of some doubt, for, as we have heretofore pointed out, the funds necessary for developing a water-power being considerable, the promoters having the affair in charge have often very naturally gone to the big electric companies for help in floating the enterprise, which they have frequently received, directly or indirectly. This in and of itself does not, however, constitute anything which is now, or is in particular danger of becoming, a trust. Allegations have been made that in the case of some important enterprises the financing has been blocked by unseen hands until it was turned into certain definite channels, leading, it is true, not directly to the big electric companies, but to the financial powers unquestionably behind them. If these allegations are true there is again immediate necessity for caution on the part of the Government lest the resources on which the people must depend in the future are gobbled up, not by the electrical manufacturers, but by organizations of capital, bent not merely on securing the water-powers, but on securing all sources of possible profit from popular necessities.

The question, in so far as there is one, is very much bigger than a mere possible water-power trust. As we have before stated, we have seen no direct evidence that such a trust does exist, and we are more than inclined to think that some well-meaning people have taken quite unnecessary alarm at the merging of power plants for the innocent and beneficial purpose of securing the advantages of united operation. A group of water-powers, as we have often pointed out, can best be developed by their physical union into a network, as in north Italy, which enables the united plants to run with greater

security from interruption than can any one, and with vastly greater possibilities in the way of conserving the flow so as to produce from a given drainage area the maximum of effect. If one or two plants of a group can secure first-class storage facilities they are often able to economize water to a very important extent and to lessen the amount of steam power required for auxiliary purposes. Water-powers when viewed from the standpoint of electrical developments are properly regarded as constituting in any given region over which physical union can be carried out, a natural monopoly which should be established and regulated rather than prevented. With suitable regulation by law, the precise ownership of the enterprise becomes a matter of indifference so far as the public is concerned. Without such regulation the public runs the risk of being squeezed, whatever the ownership.

PUBLIC-SERVICE COMMISSIONS.

The extent of the authority of public commissions over public utilities has not changed substantially during the last year. So far as commission supervision of electrical corporations is concerned, the events of the year relate largely, therefore, to the attitude of the public regulating bodies whose powers and responsibilities have not been altered materially since the beginning of 1909. Although Vermont has extended the authority of its Railroad Commission to other utilities, the most prominent commissions having jurisdiction in respect to electrical properties remain those of the States of Massachusetts, New York and Wisconsin. Of these, of course, the Massachusetts commission is the older constituted body, and as its precedents are practically established, its methods follow certain well-defined lines without revolutionary or eruptive decisions. The commissions of New York State, although created under one law and having identical authority except with respect to territory, appear to follow somewhat different methods in discharging their duties. The methods of the First District Commission seem to be more controversial than those of the commission of the Second District. It may be too early to pass judgment as to the effect of these differences upon the ultimate policies of the respective commissions. Time will show whether such differences as are manifest are surface indications only or whether they are to be embodied in final decisions.

Whatever may be the division of the responsibility for the strained relations between the First District Commission and the corporations directly concerned, it is an unfortunate element in the situation. Irrespective of the responsible cause for continuation of the agitation, the origin is probably found in the lamentable traction scandal in New York City with which the First District Commission started its career. It is not, however, in the real interest of the public to continue the state of public and political excitement over corporate affairs which found expression in the enactment of the existing law in New York State. If the commission were less interested in seeking credit as guardian angels of the public, and if the corporations would occasionaly frankly and in good grace accept a situation to which they know they must eventually bow, the cause of both public and stockholders would be better served. The commission of the Second District has jurisdiction over a territory so different from that of the Metropolitan commission that the exact duties of these two public bodies can scarcely be compared. The up-State commission has not hesitated to criticise financial or other methods which it thought incompatible with the public interest, but it has undertaken no general probing investigations, and its hearings, although open to the public, are not prolific of newspaper sensations. Its work has been conducted quietly and with a policy to make precedents slowly in the belief that its work would not be a permanent element in history unless its decisions were so fair-minded as to appeal to the respect and justice of well-balanced minds.

In Wisconsin the Railroad Commission, which has jurisdiction over public utilities, has made haste slowly and its investigation of vital questions has comprised all features involved before a determination has been made public. It has recognized the cost of establishing the business as a proper capital charge. While the utterance of one member of a commission of this character does not necessarily constitute an authoritative expression of opinion for the commission as a whole, and may indicate personal belief rather than lay down an assured program for future policy, such an utterance may prove to be somewhat alarming. For instance, one of the members of the Wisconsin commission has indicated in a public address his belief that before the securities of public utilities of Wisconsin can reach the enviable position occupied by Massachusetts securities, many, if not most, of the public utilities will have to undergo a financial regeneration. We presume that "financial regeneration" is not intended necessarily to mean receivership and reorganization, but that it is designed to convey a recommendation of voluntary scaling of securities. Naturally, this raises the question of retroactive powers of the commissions, or the retroactive powers of the laws under which they act. If it may be assumed that the laws grant authority to compel a recapitalization in accordance with the physical property found, plus some possible or arbitrary meager allowance for intangible elements, we are confronting revolutionary changes. Faulty accounting and financial methods have existed in the past, but it does not seem reasonable to conclude that law can wipe out values which may have been lost honestly in the development of properties performing public-utility service. The financial reorganization of most, if not all, of the properties in a commonwealth, with possible destruction of existing property rights, is not the solution of the problem any more than is the unfortunate practice of bankruptcy, inflation and reorganization which has prevailed in some quarters in the past. The object of a law creating a commission and the consistent purpose of a commission should be to assure and perpetuate justice as between the corporation, its security holders and employees and consumers. That the Wisconsin commission appreciates the breadth of its obligations has been indicated by decisions in favor of public utilities in cases which, without the protection of the body, public clamor would have probably led to injustice toward property rights concerned. In fact, one of the encouraging features of public-utility regulation where it is now administered as an important function of government is the protection afforded to companies when they become the target of unjust criticism, or are threatened with needless competition. The danger from such commissions is less to be anticipated from doctrinaire policies which they may lay down and endeavor to enforce, as from unwise legislation forced upon them as the result of demagogic agitation.

MAYOR GAYNOR APPOINTS DR. E. W. BEMIS HEAD OF NEW YORK CITY ELECTRICAL DEPARTMENT.

One of the first appointments made by Judge Gaynor upon assuming office as Mayor of New York City was that of Dr. Edward W. Bemis, of Cleveland, Ohio, as Commissioner of Water Supply, Gas & Electricity. Dr. Bemis, who in recent years has been superintendent of water works of Cleveland by appointment of Mayor Tom L. Johnson, has been one of the most active and able exponents in this country of municipal ownership and the doctrine of regulation of public utilities. Active advocacy of advanced economic ideas led to his resignation from the University of Chicago in 1898, where he was associate professor of political economy, which action gave rise to much discussion and controversy in the press and elsewhere on the subject of academic freedom.

Dr. Bemis was graduated from Amherst in 1880, and from Johns Hopkins University in 1885 with the degree of Ph.D. He was professor of history and political economy at Vanderbilt University from 1889 to 1892, and associate professor of political economy at the University of Chicago from 1892 to 1898. After serving as assistant statistician of the Illinois Bureau of Statistics, he occupied the chair of professor of economic science in the Kansas State Agricultural College from 1887 to 1889. For several years he was director of the Department of Municipal Monopolies in the Bureau of Economic Research of New York, and was appointed superintendent of water works of Cleveland, Ohio, by Mayor Johnson at the beginning of his first term. He is the author of numerous papers and articles on municipal government, academic freedom, trade unions, trust and monopolies, and of a book on "Municipal Monopolies" and another on "Municipal Ownership of Gas Works of the United States."

STREET-RAILWAY MERGER IN CHICAGO.

It is said that the new "Chicago City & Connecting Railways," formed by the consolidation of the South Side surface street-railway companies in Chicago, as mentioned in these columns last week, will issue at present only $22,000,000 of 5 per cent bonds. No stock will be issued at this time but there will be participation certificates, without stated value, to be divided into two classes in which the first class will receive 4½ per cent before any dividend is paid on the second class. The bonds are to be first lien on the securities owned by the new company, some of which have not been issued, but which will have a total par value of $31,406,900. Actually, it is said, the securities have a much greater value, for the $17,000,000 of Chicago City Railway stock purchased from the J. P. Morgan interests is listed in the transaction at $200 a share. It is estimated that in the year 1910 there will probably be available for interest and dividends $2,550,000. It will take $1,100,000 to pay the interest on the bonds and $1,125,000 to pay 4½ per cent on the first class certificates, leaving about 2 per cent for the second class. It is said that the bonds have all been underwritten and part of them sold.

It is believed to be probable that this consolidation will be followed, and probably before long, by a further consolidation of all the street-railway surface lines in the city and perhaps this merger will include the elevated railroads. The fact that the proposed plan of reorganization of the Consolidated Traction Company, operating lines on the extreme West Side and North Side, seems to be about accomplished, lends color to this theory, for the Consolidated company has hitherto been a stumbling block in the carrying out of plans of consolidation. There are other rumors of consolidation plans of magnitude in Chicago, and one of these is to the effect that after all the surface and elevated roads have been combined, the company so formed will be amalgamated with the Commonwealth Edison Company. Mr. Samuel Insull, president of the Commonwealth company, is one of the directors of the new Chicago City & Connecting Railways, and it is also known that he was active in an effort made several months ago to combine the elevated railways. However, it is probable that this talk is principally conjecture, and in any event, it is likely that it refers to some consummation that may be achieved, if at all, only in the rather remote future. By supplying them with electrical energy at remarkably low rates, Mr. Insull has become rather closely associated with the transportation companies in Chicago, and it is probable that his activity in these consolidation projects has grown out of this association, rather than having been undertaken with the far-reaching plan of embracing all the public utilities in Chicago. In no other city is there as large, or anything near as large, a proportion of the electricity used for railway operation furnished by the central station as in Chicago. This fact lends some plausibility to the theory that a combination of the railway and light and power interests is in prospect, but such a merger will be on such a large scale, and so many factors would have to be taken into consideration, that it is altogether likely that this project, if it exists at all, has been given no more than academic attention up to the present time.

There was some criticism of the financial aspect of the original plan on the ground that it represented overcapitalization. Mr. Walter L. Fisher, the city's traction counsel, points out that under the street-railway ordinances the city can purchase the property of the Chicago City Railway Company for what it is actually worth without making any allowance for franchise rights or paying any attention to this new capitalization.

THE MORGAN TELEPHONE DEAL.

Attorney Harrison B. McGraw, of Cleveland, who has been acting for the stockholders of the United States Telephone Company and the Cuyahoga Telephone Company who fear a merger with the Bell interests, has written a letter to Senator Burton, asking that he intercede for them in the deal. Mr. McGraw writes in this instance as a citizen. He asserts that the purchases are illegal because they destroy competition, that they will give the Bell companies unlimited power to wreck the independent companies and systems and that the public must suffer through increased rates. Of course, Mr. McGraw insists that the control of the properties was not secured by J. P. Morgan & Company for its own account, but for the Bell interests.

Replying to a letter from Attorney-General Denman asking for more evidence upon which to base a suit to nullify the sale of stocks to J. P. Morgan & Company, Attorney McGraw became rather caustic. He said he thought the Attorney-General already had sufficient evidence upon which to base a suit in quo warranto and referred him to the evidence of F. H. Goff, who testified that he sold the stock to a representative of R. L. Day & Company in the office of the American Telephone & Telegraph Company, and that the agreement was drawn up by the general counsel for that company. He said further that if Morgan bought the stock he was selected as the purchaser by the American Telephone & Telegraph Company. If further evidence is needed, Mr. McGraw said he could not furnish it.

Some of the protesting stockholders are growing impatient, as they expected the Attorney-General would bring suit as soon as the taking of testimony was completed before Notary Chestnutt at Cleveland. The office was furnished with a copy of the testimony as fast as it was transcribed, in order that there might be no loss of time. These stockholders fear that if the matter is delayed until the General Assembly meets some legislation may be enacted that will either legalize the purchases or make such purchases and mergers possible in the future, to the detriment of the independent companies.

In a letter to James S. Brailey, Jr., of Toledo, Ohio, Attorney-General Denman demanded the names of the purchasers of all the telephone properties said to have been sold to J. P. Morgan & Company. Mr. Brailey stated that the letters went to the heads of all eight of the properties in question and that replies

would be sent to the Attorney-General at once. He refused to say what the replies would contain on the ground that this would not be an act of courtesy toward the Attorney-General, but it is believed that the replies will assert that J. P. Morgan & Company are the absolute owners of the stocks they have purchased and the companies of which they have secured control.

J. P. Morgan & Company, President L. G. Richardson of the Central Union Telephone Company, with headquarters at Indianapolis, one of the Bell companies, and President Theodore N. Vail, of the American Telephone & Telegraph Company, have all written to Attorney-General Denman assuring him that the Bell interests have no connection with the deal by which these properties were transferred. Assurance was also given that there is no agreement or understanding of any kind by which the Bell interests will ultimately procure control of the independent companies.

COLORADO RULING ON MUNICIPAL OWNERSHIP.

Judge Lewis, of the United States Circuit Court of Colorado, made an important ruling in an injunction suit brought by the Glenwood Light & Water Company against the city of Glenwood Springs. The company sought to prevent the holding of an election on Jan. 4, at which it was to be voted whether the city should purchase the company's plant or build one of its own. While Judge Lewis refused to interfere with the election, he granted a temporary injunction to the plaintiff company restraining the City Council from taking any action based on the outcome of the election that would tend to injure the interests of the company. In granting the injunction Judge Lewis said that, under the terms of the franchise granted to the plaintiff company, the city has the right to buy the water plant at a reasonable figure, but has not the right to construct a municipal plant, and to do so would not be keeping faith under its contract with the company. The city has not the right, he said, to do as it pleased under all circumstances, and every sense of justice and equity is opposed, he said, to the threatened action of the defendant. The city has said to the plaintiff company, "accept our $60,000 or we will build a plant that will ruin yours," and no Court of Equity, he said, would uphold such a threat.

The Glenwood Company secured a franchise in 1887 to furnish water and light, the life of which was extended for 20 years in 1905, to date from 1907. In 1908 the Council passed a resolution providing that two appraisers be appointed by the city and two by the company to fix the value of the plant, as required by the terms of the franchise; and if the four appraisers failed to agree on a value, a fifth was to be appointed to act as umpire. The company refused to appoint the appraisers, and those appointed by the city fixed $60,000 as a reasonable price to offer for the water plant. The company declares that the value of this water plant is not less than $350,000, and that as it supplies the city with electric light as well as water under its franchise, to buy the water plant and not the electric plant would further injure the company, as the water furnished for domestic purposes is the same as that which generates the electric power for the company. As to neglect to appoint appraisers in 1908, the company contends that the Council should have passed an ordinance at that time, and not a resolution; moreover, that the resolution merely expressed the belief that the plant should be purchased, and did not bind the city in any way.

MARYLAND PUBLIC UTILITIES BILL.

The Maryland Public Utilities Act was given two public hearings last week, at which no complaint was entered by any corporation or individual. During the latter part of this week another opportunity will be given to the corporations that will be affected by the act to give their views on the subject.

There are two points in the bill that have given rise to discussion. The first is in regard to the provisions of the bill subjecting the orders of the commission to review by the courts. Attorney-General Straus, who framed the measure, stated that these provisions were made for the purpose of expediting the work of the commission and to prevent it from becoming involved in long and complicated litigation. "Under the law of the land any corporation not satisfied with the orders of the commission could take the case to court under various legal methods, and it would also be entitled to make an appeal to the Court of Appeals if not satisfied with the opinion of the lower court. If the Legislature passed any bill affecting a corporation, the corporation has a right to go to court and could have the act declared invalid if it could prove that its enforcement meant the confiscation of the property of the corporation. As a corporation has this right in regard to the Legislature itself, it has the same right in regard to all of the acts of the agents of the Legislature, and the Maryland Public Utilities Commission is an agent of the Legislature. Any provision in the act declaring that corporations would have no right to go to court on the decisions of the commission would be invalid. Now, as the corporations have this right to have the orders of the commission reviewed by the court, then the proper thing to do is to so provide for this review as to prevent delay. Without any such provision it would be possible for the corporations to tie up the work of the commission for years through different legal procedures."

The bill as now prepared provides that all applications for a review of the orders or the commission shall be made within 60 days after the order is given. If not made within 20 days of the decision of the commission it must be accepted by the corporation. If an appeal is to be taken to the Court of Appeals this must be done within 20 days after the decision of the lower court. Furthermore, in order to expedite the work of the commission, it is provided that such cases shall be given precedence over all others, except election cases. This means that they will be tried without delay, and during the same term of the Court of Appeals in which the appeal is made.

There has also been a discussion as to the right of the public utilities commission to make a revaluation of the bonds and stock issued by a public-service corporation before the passage of the act. The commission will not make any revaluation of such bonds and stock. It will simply place a valuation on the physical property of the corporations, upon which property it will issue its orders and recommendations. It is held that the act would be retroactive if it empowered the commission to make such a valuation of the bonds and stock. After the final valuations are placed on the properties then the commission will have the right to pass upon future bond and stock issues of the corporations.

TENNEY COMPANIES TO INTRODUCE PENSION SYSTEM.

The Tenney electric lighting and gas companies will shortly introduce a pension system for the benefit of employees over 60 years of age. The basis of the pension is to be 1 per cent of the employee's average annual salary for the preceding 10 years multiplied by the number of years of his service in the organization. Thus, a man receiving $1,000 per year for the past 10 years and reaching the age of 60, after being 30 years in the service of the companies controlled by the organization, would receive a yearly pension of $300. The management retains the right to withdraw the pension if it becomes desirable. The Tenney companies constitute one of the best known and most progressive organizations in Eastern public-utility circles, and this departure marks a distinct step forward in the line of welfare work. The pension system will take effect in the following companies: Malden Electric Company; Haverhill Electric Company; Suburban Gas & Electric Company, Revere; Salem Electric Lighting Company; Springfield Gas Light Company; Malden & Melrose Gas Light Company; and Fitchburg Gas & Electric Light Company, in Massachusetts; and the Concord Electric Company, of Concord, N. H. The headquarters of the organization are in Boston.

TOLEDO ELECTRICAL SHOW.

The Electrical Dealers' Association, of Toledo, Ohio, will hold its first Electrical Show and Exposition in the Coliseum Building from Jan. 31 to Feb. 5. Among the features of special interest will be a contest in bread-making by the use of electric cooking appliances. Lectures will be given daily by men of prominence in the profession. Days have been set apart in honor of the American Institute of Electrical Engineers, the Ohio Electric Light Association, the Michigan Electric Light Association and the Indiana Electric Light Association. Special invitations have been extended to every solicitor, representative central station and electrical dealer in Ohio, Indiana, Michigan and Kentucky.

The Exposition was inaugurated for the purpose of stimulating and increasing the use of electrical apparatus and appliances among all classes of consumers in the locality noted. The president of the Electrical Dealers' Association is Mr. T. D. Buckwell, and the secretary Mr. I. B. Golden.

THE NEW EVANSVILLE COMPANY.

The new central-station company in Evansville, Ind., to which reference was made in these columns last week, will be known as the Evansville Public Service Company. It has been incorporated with $250,000 capital stock, but this sum will be increased before long to $1,000,000, it is said. The men interested in the company are nearly all local business men in Evansville, 8 out of the 11 directors being Evansville men. The company was granted a 25-year franchise on Dec. 6 to furnish electric light and electric power and also steam and hot-water heating. Three per cent of the company's gross receipts go to the city as compensation for the franchise. The company starts out with the good-will of the City Council evidently, for the franchise was granted by a unanimous vote.

Steam heating will be supplied in the business section of the city and hot-water heating in the best portion of the residence section. The company has purchased a site for its plant on Canal Street between Fifth and Sixth Streets, and will proceed to build a generating station. The Central Station Engineering Company of Chicago is the designing and constructing engineer, and Mr. John A. Radford, of Chicago, is the consulting engineer for the electrical portion of the plant. A steam-turbine, alternating-current generating plant, with all modern labor-saving features, such as coal and ash-conveying machinery, will be erected. The steam-heating equipment is designed to care for 450,000 sq. ft. of radiation, while 350,000 sq. ft. of radiation for hot-water heat will be provided. Electrical conductors will be placed underground in the business district and carried overhead in the remaining portion of the city. Mr. W. B. MacDonald, formerly vice-president and manager of the Evansville Gas & Electric Light Company, with which the new company will compete, will be general manager of the Evansville Public Service Company.

FORT FRANCES, ONT., HYDROELECTRIC DEVELOPMENT.

The power dam of the Fort Frances, Ont., hydroelectric development is completed on the Canadian side, about 12,000 hp of machinery is being installed and 2000 hp is ready for immediate use. The Minnesota & Ontario Power Company, of which Mr. Backus, of Minneapolis, is president, has made application to the Government for the right to divert 6000 hp to the American side, but the residents of Fort Frances object to this amount of power being diverted as long as one-half of the power on the American side remains undeveloped and not in use. The Inland Revenue Department has granted a temporary lease of 250 hp, which will be available until March 31, and in the meantime Mr. Backus will submit his argument for any claim that he may have on any of the power to the Board of Railway Commissioners at Ottawa before that date. It is understood that the town of Fort Frances has been contending that one-half of the power belongs to the Canadian side of the river and should be used on that side of the river. They also want a rate fixed at which power can be sold for industrial purposes and as the whole matter has been referred to the Railway Commissioners and to the Minister of Inland Revenue, a delegation will go to the hearing in Ottawa whenever the Government fixes the date.

MASSACHUSETTS COMMISSION NEWS.

The Massachusetts Gas and Electric Light Commission has approved the issuance of 19,452 additional shares of capital stock by the Edison Electric Illuminating Company of Boston, the proceeds to be applied to the payment of indebtedness on account of additions to plant and the purchase of the electric properties of the Boston Consolidated Gas Company, the Waltham Gas Light Company, the Newton & Watertown Gas Light Company and the Chelsea Gas Light Company. The stock is to be offered at $215 per share.

By taking no action upon the recent distribution agreement between the Worcester Electric Light Company and the Connecticut River Transmission Company, the board has allowed the latter to become operative. The agreement provides that the Worcester company shall furnish conduit service to the transmission company through the city to the South Works of the American Steel & Wire Company, including the North Works of the latter en route. The Worcester company may provide locations and distributing facilities for such customers as the transmission company may procure, provided the distribution potential does not exceed 14,000 volts and that the total rating of the consumer's motors and apparatus is not less than 300 hp and the annual energy consumption per customer not less than 450,000 hp-hours. The transmission company may establish distribution service on its own account if the Worcester company fails to do so. For the service thus rendered, the transmission company is to pay to the Worcester company an annual rental of 5 cents per running foot for every foot of duct constructed or furnished, and for pole-line service a sum equal to 15 per cent of the cost to the lighting company of the pole lines or parts of lines furnished to the transmission company. The construction cost referred to is the cost of original construction only. The transmission company is to furnish the lighting company with the wires and cables for the above distribution lines, and the former is to perform the work of installation. The transmission company is to deal directly with all its customers and the lighting company is not to participate in the prices charged, which are to be arranged solely between the transmission company and its patrons. The lighting company is to bear no expense in the provision of distribution fixtures on the premises of the transmission company's customers. The agreement contains provisions for review after 10 or 20 years by the Gas and Electric Light Commission on appeal of the city authorities of Worcester and for arbitration by a board of three disinterested experts in case of a disagreement. In many respects the agreement resembles that recently concluded between the transmission company and the Fitchburg Gas & Electric Light Company, the two situations being in close parallel. The way is now clear for the distribution of Connecticut River energy in the Worcester field.

NEW YORK PUBLIC SERVICE COMMISSION NEWS.

Application has been made to the Public Service Commission of the First District of New York for a certificate of convenience and necessity to build an electric railway from the Hudson River, across Manhattan through Canal Street, over the new Manhattan Bridge and through Brooklyn to Atlantic and Flatbush Avenues. This proposition is backed by Brooklyn business men, Frederick W. Rowe being president, and John C. Brackenridge, vice-president. It is proposed to carry passengers at a 3-cent fare. The company was incorporated in

Albany last week under the name of the Manhattan Bridge Three-Cent Line, with an initial capital of $50,000.

Another hearing was held last week upon the second plan proposed by the bondholders of the Third Avenue Railroad Company. The only important fact brought out was the statement by F. W. Whitridge that since he had become receiver of the road he had spent between $2,500,000 and $3,000,000 for betterments. It is said that if the commission declines to sanction the present plan the matter will be carried into the courts.

The Public Service Commission has approved a contract between the Westchester Electric Railroad Company and the Union Railway Company for the joint operation of certain lines of street railway in the Bronx. This contract provides for the operation of the cars of each company over portions of the tracks of the other company.

The Manhattan Central Improvement Association, which is composed of the property owners and business men upon Thirty-fourth Street and streets adjacent thereto, has prepared a petition to be presented to the Public Service Commission favoring the construction of a moving platform under Thirty-fourth Street between Second and Ninth Avenues. The project also embraces the construction of such a platform under Broadway between Fourteenth and Forty-second Streets. It is estimated that the Thirty-fourth Street construction will cost about $6,000,000, and that it will require two years to complete it.

WISCONSIN COMMISSION NEWS.

The commission has been occupied for the past week on the hearings on the application of the Milwaukee & Fox River Valley Railway Company for a certificate of convenience and necessity. The project under consideration contemplates the construction of a line of street and interurban railway for passenger, mail, express and freight business between Milwaukee and Appleton, Wis., with branches to Kaukauna, Menasha and Fond du Lac and traversing Milwaukee, Ozaukee, Washington, Sheboygan, Outagamie and Fond du Lac Counties. The proposed system will have a total mileage of 136.92 miles. A 66-ft. right-of-way is contemplated. The territory traversed by the project is a strictly agricultural one. The counties traversed are all above the average for the State in productiveness.

The application of the Milwaukee & Fox River Valley Railway Company is being contested by the Milwaukee Northern Railway on the grounds that the proposed railway will enter into competition with its present system in a territory where there is not sufficient business for two railway systems. A great mass of testimony has been taken and numerous estimates have been submitted covering the cost of constructing the proposed road, the probable earnings from operation, the operating expenses, and the effect of the construction of the proposed system upon the receipt of the Milwaukee Northern Railway. Westinghouse, Church, Kerr & Company and the Comstock-Haigh-Walker Company have analyzed the question along the lines noted.

It has been estimated that with the cheapest type of road that it is desirable to build, the estimates being based upon the cost of similar projects through similar country and of a like character, the cost per mile will be between $30,000 and $35,000. The estimated earnings from all sources are given by the Westinghouse-Church-Kerr Company as follows: Average per mile, $2,996; average per capita, $4.23; average per total car-mile, $0.217. The estimated expenses, assuming most favorable conditions, are given as follows: Operating expense per car-mile, 15.3 cents; ratio of operating expenses to gross earnings, 10.4 cents. Taking into consideration future increase in population and earning value, the probable net loss to the Milwaukee Northern Railway resulting from the construction and operation of the proposed railway will be $250,000 or upward.

The estimates submitted by the Comstock-Haigh-Walker Company contain the following explanation: "In estimating the earnings of the Milwaukee & Fox River Valley Railway, the ordinary method of assuming a per capita amount for the population (not including the terminal) of the cities and villages through which the road will run, and then taking a sufficiently wide strip of country as tributary to give the total earnings desired, has been done away with and an estimate made on the basis of the earnings per car-mile to be operated. In order to make an estimate of any value it is necessary to have the earnings of operating properties with which you are familiar in all the details. The gross earnings are not directly proportional to the operating expenses, and in few businesses are the operating expenses so independent of these earnings as in the interurban railway business. In fact, unless the passenger travel is too heavy to be carried by the regular trains provided by the schedule, the costs of operation are for all practical purposes the same whether the cars are comfortably filled with passengers or absolutely empty; and therefore until such time as the travel requires additional car mileage for its accommodation, the entire operating expenses is a fixed expense and there is no variable expense based on earnings or its equivalent, namely, the number of passengers carried. The terminal of the Milwaukee & Fox River Valley Railway is Milwaukee, which is also the terminal of the Milwaukee Northern. This city is the absolute terminal of the country traversed as far north as the 'Interurban Through Ride Distance.' The location of this 'Through Ride Distance' is one of the most important elements which enter into the probable earnings of this proposed railroad, and if the large cities at the termini of the various branches would not be tributary to the main terminal Milwaukee, via the proposed Milwaukee & Fox River Valley Railway—by which is meant that the through travel would be carried by other existing railroads—then this road should be considered as a system having more than one main terminal city. The proposed location of the Milwaukee & Fox River Valley Railway would, if this proposed railway should be successful in securing the through travel or a large proportion of it, divert it from its present line and carry it through new territory. Whether the traveling public would take kindly to this change depends upon the inducements offered, and therefore an examination of the present transportation facilities is necessary."

It was claimed by witnesses for the Milwaukee Northern that if the proposed railway reduced the rate from Cedarburg to Milwaukee to secure the business, the business secured will be carried without profit or at an actual loss. It was stated that experience has shown that where a rate lower than the standard rate is put into effect between a point situated similarly to Cedarburg and the main terminal city like Milwaukee, the passengers coming from points beyond will purchase to Cedarburg and then travel on the reduced rate.

TESTS OF WIRELESS.

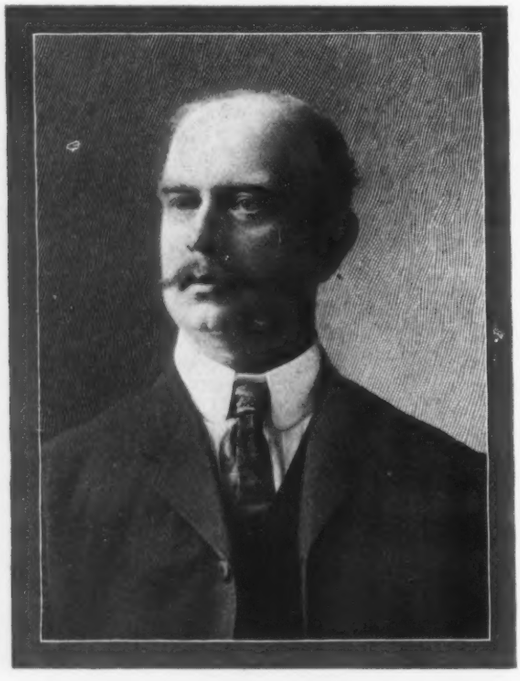
During a recent test of wireless telegraphy, made with apparatus aboard the scout cruisers *Salem* and *Birmingham*, which were 1000 miles from each other and 1000 miles from the high-powered wireless station at Brant Rock, Mass., there were serious interruptions in the communications between the two ships and the shore station. A fierce storm was raging at the time of the tests and the naval officers are said not to consider that the tests proved the apparatus to be a failure, and a conference will be held soon with the representative of the contractor who installed the equipment with a view of arranging for further tests. During the next test the ships will be stationed about 2000 miles from Brant Rock. This will require one to be near Trinidad and the other 1000 miles out from the South American coast. The supreme test will be the location of the ships on the African coast, 3000 miles from Brant Rock and 1000 miles apart. If these tests are successful a tower 100 ft. higher than the Washington monument, which is 555 ft. in height, will be erected in Washington for communication with ships over a distance of 3000 miles.

AMERICAN ELECTRICAL ENGINEERS—I.

Dr. Louis Bell.

Dr. Louis Bell was born Dec. 5, 1864, at Chester, N. H., the son of Gen. Louis Bell, U. S. V. After graduation in 1880 from Phillips Academy, Exeter, N. H., he entered Dartmouth College, from which he was graduated in the class of 1884 with the degree of A. B., and with final honors in physics. Entering Johns Hopkins University as a post-graduate student in 1884, he was appointed Fellow in Physics the following year, which honor was continued until 1888, when he received the degree of Ph. D. The summer of 1887 was spent abroad in travel and in some special research work, during which period Dr. Bell presented two papers at the Manchester meeting of the British Association for the Advancement of Science.

On receiving his doctorate, Dr. Bell was appointed professor of physics and applied electricity in Purdue University, Lafayette, Ind., where he organized the course in electrical engineering. While in Purdue he published in the *Electrical World* the first complete efficiency test of an electric railway. In 1889 he resigned to become a member of the firm of Bliss &



Dr. Louis Bell.

Bell, consulting engineers, in Chicago, and in the winter of that year installed the electric railway at Dubuque, Ia. Early in 1890 he went to New York and assumed the editorship of the *Electrical World*, which he continued until 1892, when he resigned to become chief engineer of the then recently organized power transmission department of the General Electric Company. In this capacity Dr. Bell designed and installed the early three-phase machinery of the General Electric Company, including the first three-phase transmission plant for general service—at Redlands, Cal., September, 1893. The original generators designed and installed under his direction are still in service there after 16 years' of service. The following year he installed the first polyphase transmission plants for cotton-mill driving and for electric railway operation—at Taftsville, Conn. The pioneer work of Dr. Bell during this period in electrical transmission of power and in the development and application of the induction motor was of the highest importance in placing these branches on an engineering and commercial basis in this country. In 1894 he took charge of the General Electric power works in the Chicago territory, and in 1895 resigned to take up work as a consulting engineer in Boston, where he has continued to the present time in general practice as consulting engineer for many power and lighting companies.

Dr. Bell has been a contributor to the technical journals for the past 20 years, and also to the *American Chemical Journal, American Journal of Science, Philosophical Magazine, Astrophysical Journal* and to the *Transactions* of various engineering and scientific societies. He is the author of "Electric Power Transmission," the standard treatise on the subject and now in its fifth edition; "The Electric Railway" (with Mr. Oscar T. Crosby), which was the first systematic treatise on the subject, and of which many thousands of copies were printed; "Power Distribution for Electric Railways" (now in its third edition), and the "Art of Illumination." The two first-mentioned books have been published in French and German translations. He contributed the illumination section of the "Standard Handbook," the article on power houses to the Encyclopedia Americana, the article on electric power transmission to the tenth edition of the Encyclopedia Britannica and the articles on electric power transmission and electric motors to the eleventh edition of the same work, now in course of compilation. Dr. Bell lectured on Power Transmission at the Massachusetts Institute of Technology 1895-1905, and served as chairman of the Incandescent Lamp Committee of the National Electric Light Association 1895-1900, and as secretary of the power transmission section of the International Electrical congress of St. Louis, 1904. He has taken out some 25 patents, chiefly electrical, and has testified in many patent litigation cases.

Dr. Bell is at present consulting engineer to the Edison Electric Illuminating Company of Boston, in the service of which he spent the summer of 1908 on a roving commission through Europe looking up improvements in lighting; also consulting engineer to the city of Hartford, for which he completely reorganized the street lighting. He is a member and past manager of the American Institute of Electrical Engineers, and member of the A. I. E. E. International Electrotechnical Commission; member of the National Electric Light Association; past-president and charter member of the Illuminating Engineering Society; vice-president of the Illuminating Engineering Society of Great Britain; fellow of the American Academy of Arts and Sciences and member of its Rumford Committee. He is a member of the University Club, of Boston, among others, and director of the Massachusetts Rifle Association for 10 years past and member of the U. S. Revolver Association of its 1902 International Team. In 1892 he was the first winner of the Winans Trophy for amateur revolver championship of the United States. During the Spanish War in 1898 he was technical officer for the Volunteer Electrical Corps on mining defenses, doing the work of a Captain of Engineers.

CURRENT NEWS AND NOTES.

American Bell in Missouri.—Following the taking of testimony in the Missouri telephone merger hearing, which was completed on Dec. 28 with the exception of two witnesses, who will be called at a supplementary hearing late in January. Attorney-General Major said that he regarded the testimony given of great value in showing that the American Telephone & Telegraph Company is a holding company for Missouri telephone companies in violation of the State corporation laws.

International Scientific Congress.—The opening of the International Scientific Congress to be held in Buenos Aires has been deferred from May 25, the original date, until July or August. The following Americans living in Argentina form a committee of the congress representing the United States; Prof. Walter Gould Davis, chairman (chief of the Argentine Meteorological Service); Prof. C. D. Perrine (head of the Córdoba Observatory); Prof. R. H. Tucker (in charge of Carnegie Observatory, San Luis), and L. G. Schultz (chief of Magnetic and Solar Physics Division, Meteorological Service).

Canadian Monorail Road.—According to reports from New Westminster, B. C., work has been begun on a gyroscopic railway which will encircle Okanagan.

Insurance for Employees.—The officers of the Philadelphia Rapid Transit Company has decided to give $500 free insurance to all employees in its service. They have also decided to give pensions of $20 a month to all employees who have been 25 years in the employ of the company and have attained the age of 65 years.

Withdrawal of Power Sites.—An order was issued on Dec. 31 by Secretary Ballinger, of the Department of the Interior, for the temporary withdrawal from all firms of disposition of about 94,000 acres of land thought to be valuable for water-power sites. The land withdrawn embraces 27,000 acres in Colorado, 63,000 acres in Arizona and 3700 acres in Oregon.

Single-Phase Traction.—Among the special courses announced for King's College, London, is one of 10 lectures on single-phase traction to be delivered by Prof. Ernest Wilson and Mr. Frances Lyndall. The former will discuss the principles involved, while the latter will deal with the practical side, with special reference to the Rotterdam-Hague and Heysham-Morecambe single-phase lines.

Pacific Wireless System.—As a result of a conference of representatives of the British Admiralty of Australia, New Zealand and the Fiji Islands, recommendations have been made that high-power wireless telegraph stations be established at Sydney, Doubtless Bay, New Zealand; Suva, capital of the Fiji group, and Ocean Island; and medium-power stations in the New Hebrides and Solomon Islands. All of the stations will be under the control of the British Government.

Magnetic Survey.—Dr. L. A. Bauer, of the Carnegie Institution at Washington, under whose direction a general magnetic survey of the earth has been begun, has reported to the American Association for the Advancement of Science the results of observations made by means of the survey ship *Carnegie*. During a cruise to England there was revealed a systematic error in the navigator's compass charts amounting on the average to about 1 deg. Errors of importance have also been found in the existing charts of the dip of the magnetic needle and of the strength of the earth's magnetic force.

Electricity in Boston New Year Celebration.—Electricity played a most prominent part in the decorations of the principal Boston hotels on New Year's Eve. The Hub was unusually enthusiastic in its reception of 1910, and numerous electric signs and artificial floral decorations bore witness to the gaiety of the occasion. Electrically illuminated flowers were employed freely; in many dining rooms and cafés the lighting circuits were arranged to permit cutting off and resumption after a few seconds on the stroke of midnight; and in one or two instances models of airships electrically lighted were suspended in the center of the room with electric sign attachments.

Public Service Valuation.—At a joint meeting of the American Economic Association and the American Political Science Association, held in New York on Dec. 30, Mr. F. W. Whitridge, receiver of the Third Avenue Railroad, read a paper entitled "Official Valuation of Private Property," in which he criticised severely the attempt of the Public Service Commission to place a replacement value upon public-utility property. He expressed grave doubt concerning the ability of experts to place proper values upon such property. In a paper by Prof. H. C. Adams, of the Interstate Commerce Commission, it was claimed that an authoritative valuation is essential to the determination of the reasonableness of the price paid by the public for services rendered by corporations, and that without such valuation it is not possible to administer in an equitable manner laws for the control of security issues by public-service corporations.

Barium for Impregnating Battery Plates.—A patent was granted to Mr. Hugh Rodman on Dec. 28 for a process of treating Planté negative plates involving the use of barium. The plates are so impregnated that the pores of the active material contains an expander to overcome the shrinkage of the active mass. The dried plates are dipped into a solution of a soluble salt of the strontium-barium group, such as a barium nitrate, and subsequently into a dilute solution of a soluble sulphate, such as sulphuric acid or sodium sulphate, thus precipitating by the chemical reaction barium sulphate in a finely divided state in the pores of the mass. The patent contains 33 claims, the leading one of which is: The method of reducing depreciation in Planté negative plates, which consist in impregnating the active mass or mass to become active, with a compound of the barium group.

Boston Edison Employees' Lecture Course for 1910.—President L. L. Elden, of the Edison Employees' Club, Boston, announces that a course of 12 lectures on "Alternating-Current Systems and Apparatus" will be delivered in the auditorium of the Edison Building, 39 Boylston Street, Boston, by Prof. Sydney W. Ashe, of Brooklyn, N. Y., during the coming weeks. The lectures will be given at 1 p. m. and 8 p. m. on Thursdays, weekly, beginning Jan. 6 and ending March 24. The lectures will cover in detail the theory, design and operation of the principal types of apparatus employed in the operation of an alternating-current system, and will be illustrated by experiments. Tickets for the full course are sold at $2.50, and outsiders who may be interested are invited to attend. During the past year Professor Ashe gave a course of engineering lectures before the club, and these were so well received that it was decided to continue the work in 1910.

Boston Section A. I. E. E. to Meet at Tufts College.—A special meeting of the Boston Section of the American Institute of Electrical Engineers will be held at Tufts College, Mass., on Saturday, Jan. 8. An invitation has been extended to the members and friends of the Institute to visit the laboratories and shops of the Engineering School between 4 p. m. and 6 p. m., where guides will be furnished. At 6:30 p. m. a dinner or luncheon will be served. At 8 p. m., in Robinson Hall, Dr. William L. Hooper, of Tufts College, will deliver an illustrated lecture on "The Necaxa Development of the Mexican Light & Power Company." In view of the success which attended the recent meeting at Harvard University it is anticipated that this second informal college meeting of the season will be largely attended. Aside from the promotion of sociability which the meetings afford, the relations between the engineering schools and the practicing engineer are being strengthened by these gatherings.

Boston Engineering Society Sections to Dine.—A joint meeting of the Boston sections of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, with the Boston Society of Civil Engineers will be held at the Hotel Somerset, Commonwealth Avenue and Charlesgate East, Boston, on Friday, Jan. 21. The meeting will be preceded by a reception and dinner in recognition of the visit at that time to Boston of Mr. George Westinghouse, the recently elected president of the American Society of Mechanical Engineers. Other distinguished guests will be the incoming president of the American Society of Civil Engineers, Mr. John A. Bensel; President Lewis B. Stilwell of the American Institute of Electrical Engineers, and President George B. Francis, of the Boston Society of Civil Engineers. Addresses will be delivered by some of the invited guests, and following the dinner a paper will be presented on the "Main and Auxiliary Machinery of the Battleship *North Dakota*," illustrated by lantern slides, the author being Mr. Charles B. Edwards, of the Fore River Ship Building Company.

Maine Electric Association.—The next meeting of the Maine Electric Association will be held at Lisbon Falls on Wednesday, Jan. 12, at which papers will be read and discussed on the relations of central stations and electrical contractors. Mr. F. D. Gordon, Auburn, Me., is secretary.

Chicago Electric Club.—Mr. Robert N. Holt, assistant corporation counsel of the city of Chicago, addressed the Electric Club, of that city, on Dec. 29, taking as his subject "The City Law Department." A feature of the meeting was the "roll-call," each man present getting up and giving his name and that of his company.

Cost of Electricity in Honolulu.—In an item going the rounds of the newspapers it is stated that in Honolulu the central-station rate is 1¼ cents per kw-hour, and as a consequence "electricity is generally used as fuel in preference to coal or wood." We are informed by the Hawaiian Electric Company that the actual rates in Honolulu vary from 17 to 6 cents per kw-hour.

Tungsten Vs. Gasoline Park Lighting.—Central Park, in New York, is now being lighted with 1477 60-cp tungsten lamps, which have been substituted for 400 gasoline lamps. The increase in the number of the lamps affords a better distribution of light, and permits the illumination of many dangerous places, particularly the bridges leading over the cross roads.

A Long-Distance Lecture.—On Dec. 15 a considerable feat in long-distance telephoning was accomplished between Washington and New York. In the former city were Commander Peary, Andrew Carnegie, Dr. Alexander Graham Bell and Admiral Chester, as speakers, and in the latter 82 people dining with the directors of the Associated Press. Every New York auditor used a "watch-case" receiver. The service over 225 miles was perfect. The strength of the current was augmented at Philadelphia by so-called "repeaters."

National Electrical Code in New York City.—Commissioner O'Brien, of the Department of Water Supply, Gas and Electricity, New York City, announces that until further notice the devices and materials included in the list of electrical fittings as issued by the Underwriters' National Electric Association, under date of October, 1909, are authorized for use in the city of New York, subject to such additions and modifications as may be deemed necessary from time to time.

Edison Round Table.—The December holiday number of the *Edison Round Table*, the monthly magazine published by the Commonwealth Edison Branch of the National Electric Light Association, in Chicago, is an especially attractive production. It is printed in green and red, and all articles and departments are characterized by the helpful, optimistic spirit that should mark the holiday season. An amusing cartoon by Mrs. W. H. Ott hits off some of the hobbies of the men in the organization. With this issue Mr. R. F. Schuchardt relinquished the editorial direction which he has maintained at such a high standard. The new editor is Mr. Ernest A. Edkins.

Christmas Wreaths for Arc Lamps.—Electrical men in Denver are notably enterprising and progressive. One of their latest accomplishments consisted in combining a manifestation of the Christmas spirit with the cheerfulness of the electric light. This has been frequently done in interiors, but in Denver the idea has been carried a step farther, and wreaths of Christmas-green ornamented arc lamps used for street lighting during the recent holidays. On Sixteenth Street, where each street lamp-post supports two arc lamps, every lamp was centered in a Christmas wreath, and the effect was striking and unique.

Smoke Nuisance in Chicago.—In his annual report to the Mayor, Mr. Paul P. Bird, smoke inspector of Chicago, says that he believes it is only a question of a few years until all the railroads entering Chicago must electrify their terminals. This year has been a busy one in Mr. Bird's department, which is said to be too small for its work, although it is declared that the city was never so free from smoke as at present. The most noticeable improvement has been in the central business district and in the manufacturing districts nearest to the center of the city. There has been also considerable elimination of smoke in the stockyards district and in the more remote manufacturing districts.

N. E. L. A. Electrical Solicitors' Handbook.—The preparation of a new edition of the "Electrical Solicitors' Handbook" of the National Electric Light Association will shortly be commenced. The sections on electric motors and illuminating engineering will in particular be submitted to careful revision, the aid of the Motor Manufacturers' Association having been enlisted in connection with the first-mentioned section. The suggestion has been made that in the revision it would be desirable to secure also the co-operation of the N. E. L. A. Manufacturing Association, acting through a committee of that body representing various lines of electrical apparatus and appliances.

Edison and the Chinese Minister.—Recently Wu Ting-fang, retiring Chinese minister to the United States, visited Edison at his laboratory, and, after inspecting the inventor's plant and asking innumerable questions about everything he saw, talked into one of Mr. Edison's phonographs. The record which he left behind him is as follows: "Dec. 24, 1909.—Mr. Edison has just showed me a great many wonderful things. He is a great man. I have heard about him for many years and have always wanted to meet him. He also has heard of me, he says, and I think we are both glad that we met. He is a remarkable inventor, typifying this twentieth century, the age of great things. Mr. Edison is still a young man and will do yet more wonderful things."

Institution of Mining Electrical Engineers.—The first meeting of the Institution of Mining Electrical Engineers was held at Manchester, England, on Dec. 18. The preliminary organization was effected last April, and at the present meeting officers were elected as follows: President, Mr. William Maurice; vice-presidents, Mr. W. C. Mountain and Prof. W. Robinson; secretaries, Messrs. Saunders, of Derby. The official organ of the Institution will be the *Iron and Coal Trades Review*. In his address upon assuming office, Mr. Maurice said the body must beware of posing as a highly technical organization. "It is, above all, an educative association, and must work with the managers and owners of collieries. The movement was one entirely for the benefit of the coal-mining industry."

Chicago Street Lighting.—The proposition of the Sanitary District of Chicago to purchase the substations and distribution lines owned by the city of Chicago and used for street lighting was discussed at a recent meeting of the trustees of the Sanitary District and the finance committee of the City Council. The argument of the Sanitary District, which generates electricity from the water-power of the Chicago Drainage Canal, is that if the city will turn over to it its street-lighting equipment the money realized from the sale may be used to make badly-needed street-lighting extensions, which will thus be obtained without cost to the city, the Sanitary District agreeing that the operating cost shall be at least as low as at present. At the recent conference it was agreed that Mr. E. B. Ellicott, electrical engineer of the Sanitary District, and Mr. William Carroll, city electrician of Chicago, prepare a statement to show the cost of all lines and substations now owned by the city.

NEW THEATER, NEW YORK CITY.

Electrical Equipment and Illumination of the Most Artistic Theater in America.

By N. M. SCHOONMAKER.

THE New Theater, located at Central Park West and Sixty-second Street, New York City, and recently opened with much pomp and ceremony, is as distinctive from other theaters in the design of its electrical equipment as it is in policy. Its purpose is similar to that of the national theaters of Europe, and while it lacks the national support and protection accorded to these, it is, nevertheless, backed by practically unlimited capital and has been designed to suit a wider range of needs. The edifice has been erected with the purpose in view of fostering dramatic art, so that plays which are impossible to the ordinary stage manager, owing to the cost of their production, if they possess real dramatic value, may be produced. The playhouse is also intended for operatic and orchestral productions, so that the electrical equipment is much more elaborate than that found in the ordinary playhouse in order to cover the needs of such performances. The edifice is thus a theater, an opera house and a concert hall.

Fortunately the gentlemen responsible for the building of the theater look for no interest on their investment, but sought only to produce a playhouse commensurate with the high ideals which prompted its erection, and having its mechanical equipment capable of the highest efficiency. The central idea around which the edifice was fabricated had its effect on the construction of every part. The executive rooms are very large and elaborate. The halls are spacious and dignified. The seating capacity is greater than usual. There are a buffet, several tearooms, libraries and lounging-rooms. The dressing and rehearsal rooms are large and numerous. A roof garden and terrace are provided. The stage itself is very extensive in all its dimensions, and upon it has been expended more thought and labor than perhaps upon any other stage in existence. The pit below the stage is 30 ft. deep, and there is a clear height from the stage floor to the rigging loft of 117 ft. A second stage is placed in the pit below the one being used, and upon this scenes may be set while a performance is going on and at the proper moment the lower stage may be quickly elevated to take the place of the other one.

The stage is also equipped with a revolving floor, which makes it possible to set four scenes at once, so that in shifting from one act or scene to another it is only necessary to turn the stage through an angle of 90 deg. For Shakespearean plays the floor of the orchestra pit is arranged to lift up, and thus give considerable added space to the regular stage. A four-color lighting scheme is used in the borders, strips, foots and pockets, the colors being red, white, blue and amber. The borders and foots are arranged in four sections across the stage, four colors each, each separately dimmed and separately controlled. It will be appreciated that the problems for the electrical engineers were numerous and unique, inasmuch as the New Theater was planned to be the most elaborate in the world. Moreover, the requirements for its lighting were most exacting, it being desired to have it represent not only the highest development in the art, but also to produce niceties of light and shade such as were not attempted before.

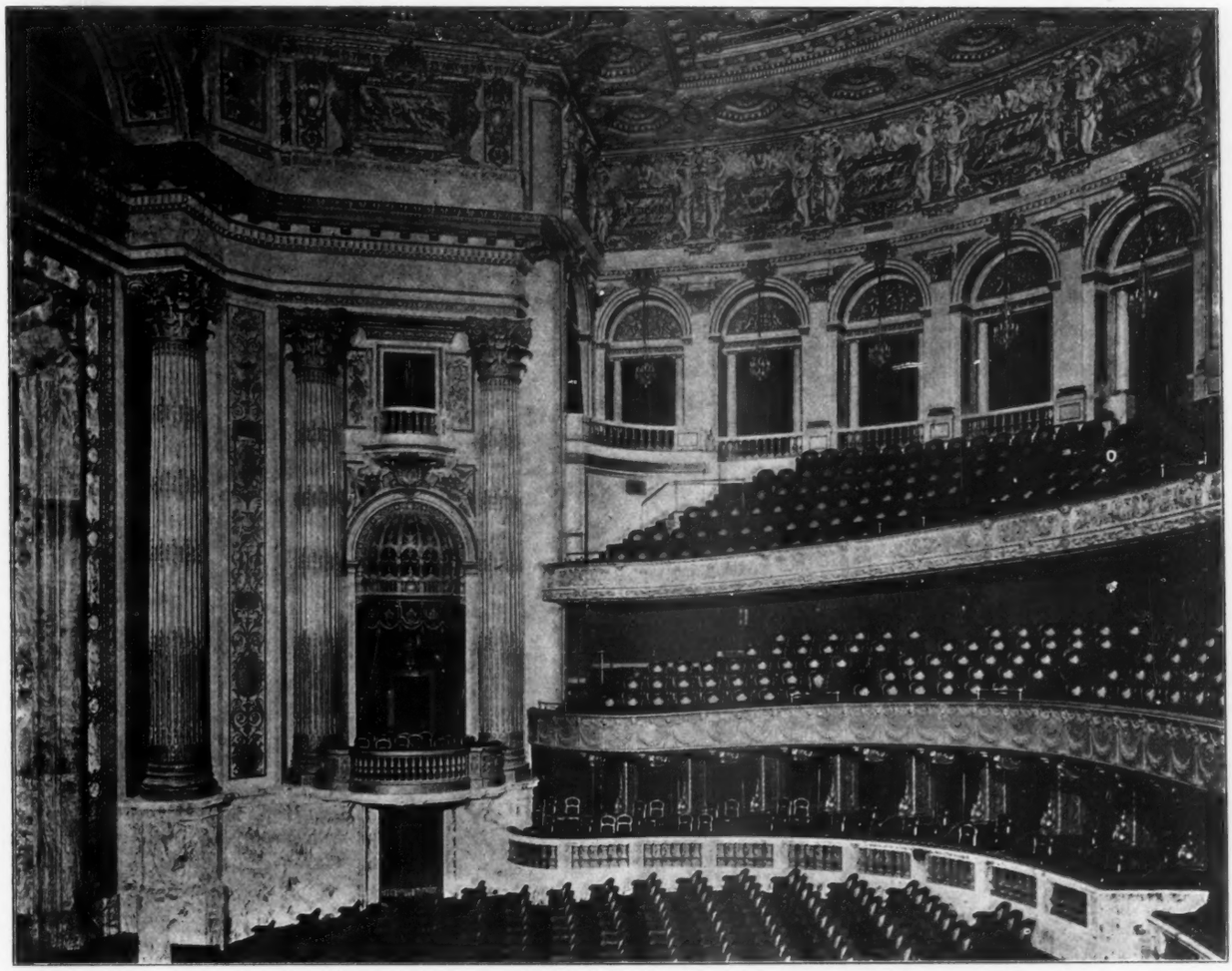


Fig. 1—Side View of the Auditorium of the New Theater.

SERVICE.

The electric service is taken from the mains of the New York Edison Company, and feeds a total equipment of approximately 19,000 incandescent lamps and 1131 hp in electric motors. The addition of such a considerable load could not be carried by the ordinary mains in the district, so that it was found necessary to run two entirely new feeders from the New York Edison substation and in addition to loop in two mains and tap from a third. This work necessitated the opening of the street from the theater to the Edison substation. The service feeders drop through the coal bunker to the sub-basement, where the main service board is set on the outside wall in the engine-room. The latter was built with the idea of eventually installing generating sets and foundations were constructed. The Edison service board is placed in such a way that it can be taken out and replaced by generator panels and connected with future sets of units, should these be installed.

According to the ordinances of the City of New York, three independent services are required in all theaters: one for auditorium and stage lamps, one for all corridor and public passage lamps, and one to be used exclusively for the lamps in the red exit signs. The engineers of the New Theater, however, went even further than the law required. In addition to the three lighting services an extra service was brought in for motors, so as to make it possible to keep the motor circuits separate from the lamp circuits. The engineers also took the precaution to place the meter for the red exit lamps on the service board. This was done in order to keep the number of fuses in the line down to a minimum, as well as to lessen the possible chances of having these lamps extinguished owing to a mishap on the

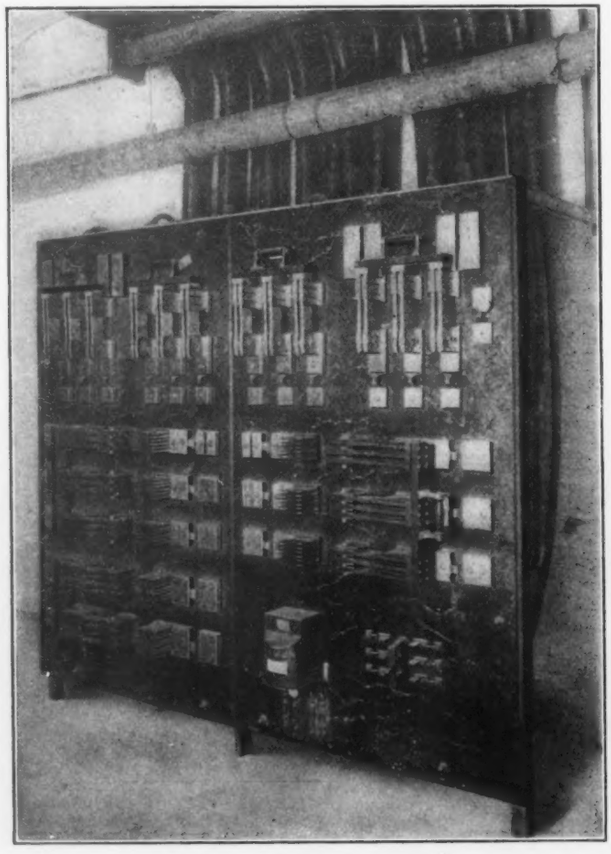


Fig. 2—View of the Edison Service Board.

switchboard or if an operator unintentionally opened the circuit. The other three services, one for motors and two for lamps, are arranged so that they can be thrown together by means of double-throw switches on the main switchboard. The switches are placed so that the motor buses can be thrown to the motor service or to the auditorium service, the auditorium buses to the auditorium or corridor service, and the corridor buses to the corridor or auditorium service.

SERVICE SWITCHBOARD.

The service switchboard is constructed of marbleized slate,

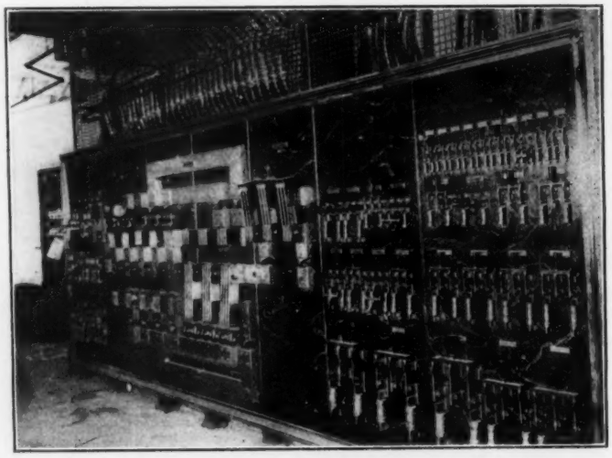


Fig. 3—View of General Distribution Board.

and the only noticeable point in its construction is that the switches are of the double-throw type, so that in case of a blow-out of a service fuse on the board or of a feeder fuse in the street, the switch can be thrown over to the other side while renewing the fuse. Upon this board is also mounted a watt-hour meter for the exit lamps, these lamps being controlled from this board for the reason just stated. In its general construction the switchboard is similar to a switchboard with a copper-bar service behind and double-throw switches for each service. From this board the three main services are carried across the sub-basement ceiling directly to the main switchboard located on the opposite side of the engine-room and which, should an isolated plant be installed, would be the distribution section of the power-plant board. In order to minimize in copper, it was decided to use lead-sheath, paper-insulated cable for this run overhead. This was preferred to rubber-insulated cable because it has a greater allowable current-carrying capacity for the same cross-section of copper and the drop in either case is negligible. The use of paper-insulated cable, however, intro-

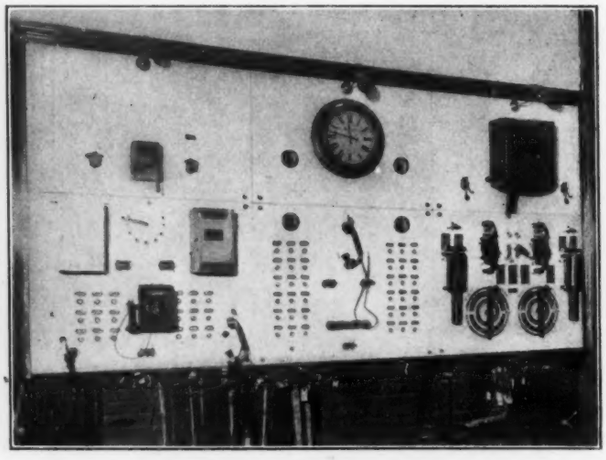


Fig. 4—Stage Manager's Board.

duces an added complication, because of the necessity of having potheads at both ends of the run, and these take up considerable room. At the switchboard end the potheads are set on special supports over the board, and at the service end they are supported on the wall behind the service board. The cables

are, of course, enclosed in iron conduit. Three-wire feeders, each leg of which is made up of four 800,000-circ. mil cables, are used for the stage and auditorium; similar three-wire feeders are used for the corridors, and two-wire feeders, each leg

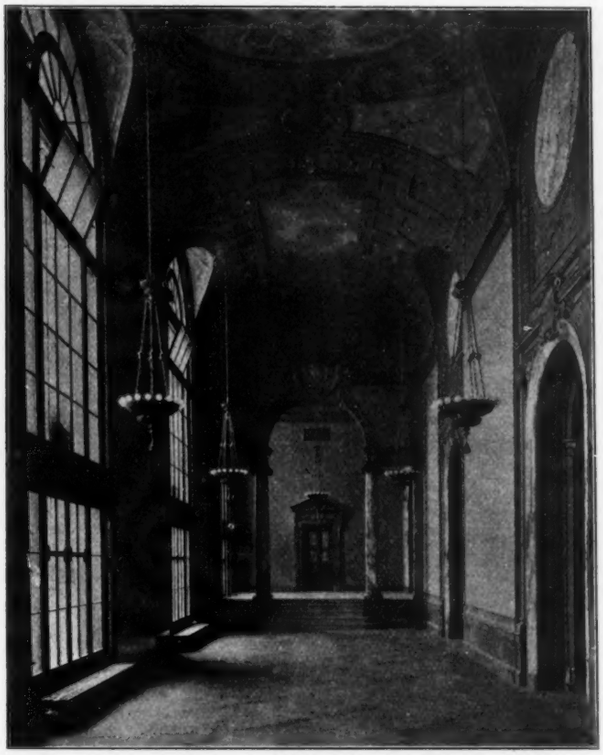


Fig. 5—General View of the Foyer.

of which is made up of six 700,000-circ. mil cables, are employed for the motor service.

MAIN SWITCHBOARD.

The main switchboard is built of marbleized slate, all the connections being made with copper bars and strips upon the

Fig. 6—Lobby of the New Theater.

back of the board. No meters are mounted on the board, and the space above it is made in the form of a big pull-box in which all feeders terminate. The latter come up from the switch studs to the box in the shape of hard-drawn copper rods covered with neatly fitted circular-loom conduit, and supported by porcelain insulators fastened to iron bars. The rods are connected to the feeder cables by means of Dossert connectors, and the work on the feeders at this point was done with the greatest possible care in order to make everything safe, secure and durable. This board is divided into buses, and back of it, running its full length and mounted on the wall, is a meter board. The latter is placed inside the switchboard enclosure and is connected to the switchboard by means of insulated copper bars, which run overhead and which feed the bus-bars of each board. The New York Edison Company decided that more accurate metering for the large electric sections of the building could be obtained by using a number of small meters connected in parallel. The company made these individual meters as small as possible, and, while there is not quite one to each section, there are 24 mounted on the meter board. The large sections could not be cut up, so meters for these are connected in parallel.

The following switches, which give the engineer control of the building and sections, are mounted on the switchboard: One each for stage lamps, auditorium lamps, executive quarters south, corridors, carriage calls, decorations and festoons around the roof, buffet and basement, executive quarters north, roof garden, dressing-rooms north; two each for marquise south, marquise east and for marquise north (future); one for lamps in the fanroom in the basement, one for ceiling lamps, 10 for engine-room lamps and three for future lamps. The following motor switches are also on this switchboard: One each for stage motors, south basement motors, north basement motors, buffet motors, roof motors, attic kitchen motors, fire pumps, sprinkling pumps, air compressor, elevator No. 5, elevator No. 7, lift No. 11, and three for future motors.

Nearly all of the wiring is enclosed in rigid iron conduit. This work is of exceptionally high character and was installed with the greatest pains and care. Twenty-six feeders leave the main switchboard and supply the various sections as indicated above. All portions of the distribution system which it is not desired to control from the stage switchboard are fed directly from the main switchboard by sets of feeders run in iron conduit exposed on the ceiling of the basement to the riser shaft, and then looped up through various distributing boxes. Instead of using small pull boxes it was decided to use large boxes for the entire group of feeders, and the feeders inside the boxes are supported on porcelain cleats.

According to the city ordinances the operator of the stage switchboard cannot have full control over the lamps in the corridors and public sections of the building. These parts of

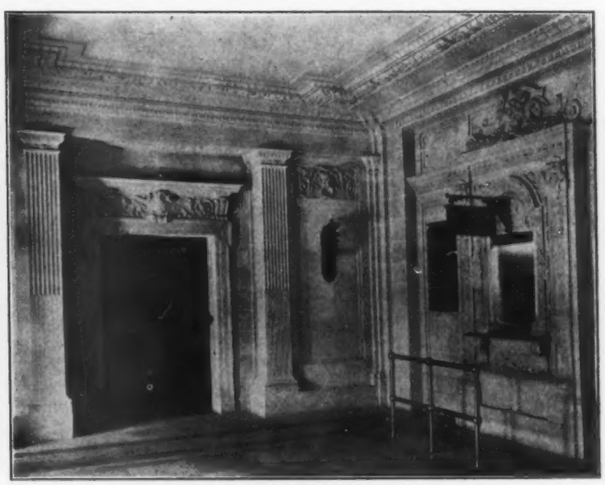


Fig. 7—Box Office of the New Theater.

the New Theater, however, are so very large and numerous that if the lamps in them were allowed to burn throughout the performance the energy used would be quite considerable. In order that these lamps may be cut out of circuit while the performance is on, and also in order to be able to dim the lamps as

a signal to those in the corridors and public sections that the performance is about to begin, the fixtures are double circuited. one-third of the lamps being connected to one circuit and two-thirds to another circuit. All of the lamps are fed from the same feeder, control being effected by means of remote switches set at centers of distribution and in distribution boxes. The

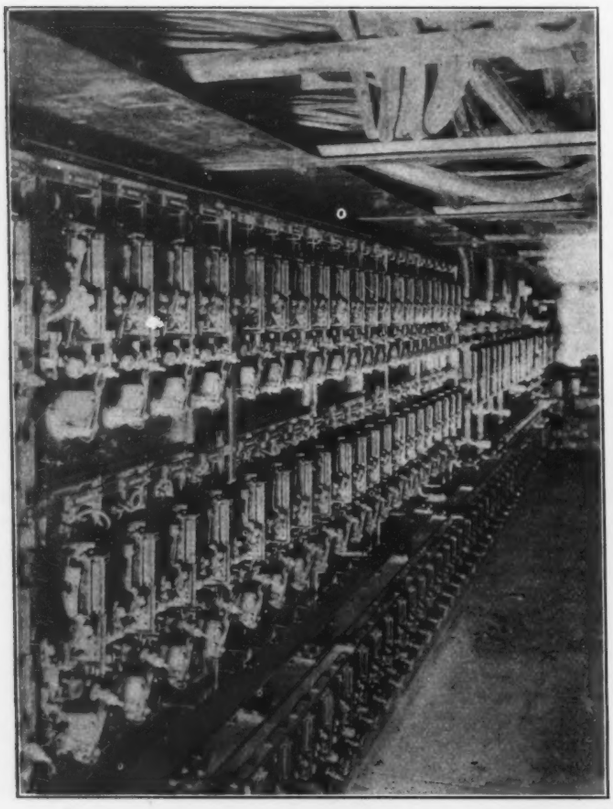


Fig. 8—Remote Control Switchboard.

circuits having the greater number of lamps are controlled by the stage operator. This double-circuiting increased the cost of the branch-circuit installations in these sections of the building almost 100 per cent, but, in view of the fact that considerable energy could thereby be saved, it was felt that the ex-

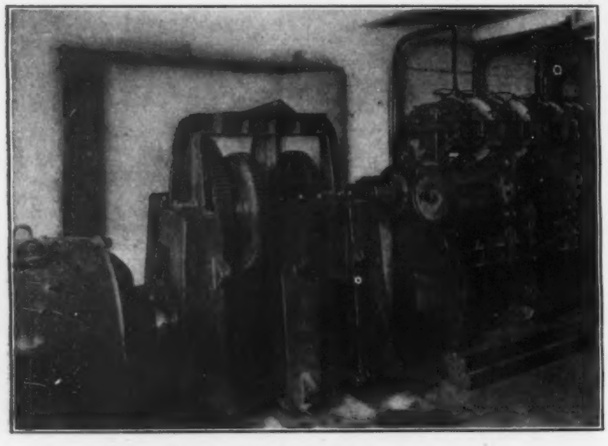


Fig. 9—Motor-Driven Dimmers.

pense was justified. Aside from this complication the wiring of this part of the building presents no unusual points.

STAGE SWITCHBOARD.

All lamps in the auditorium and all lamps in and about the stage, operating and others, must, of course, be controlled by the operator of the stage switchboard. In this case, however, owing to the size of this part of the building, the elaborateness of its construction, the fact that there is limited space in the wings and that the stage is equipped for operatic performances —the latter feature making very exceptional demands for unusual lighting—it was decided to place the switchboard operator in the center front of the stage, in a position usually occupied by the operator in foreign theaters, and in the position usually occupied by the prompter in American operatic performances. The switchboard operator is concealed under a hood, with his eyes just above the stage floor, thus giving him a view of the stage from the viewpoint of the audience, enabling him to regulate the gradations of light with more satisfaction.

It has been universal stage practice to give to this stage operator when in this position control of only the master dimmer switch, while assistants were given control of the individual switches and individual dimmers. In the arrangement of the New Theater, however, this part of the installation has been designed with the utmost refinement and the stage operator is given not only control of every individual switch and dimmer, but of all the master switches and dimmers as well. In order

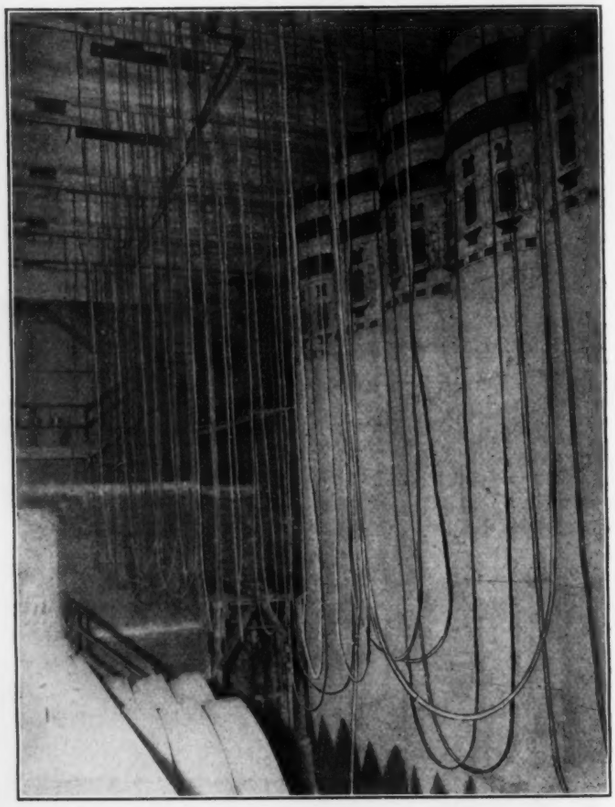


Fig. 10—Under Side of Stage, Showing Pocket Cables.

to simplify the control, all the switches of the stage switchboard are of the remote-control type, as well as all the dimmers. By such an arrangement the size of the operator's control board is very much smaller than the other two, and he is able to manipulate the switches and dimmers without even so much as moving his head from the hood.

The problem of the engineers was to clear the stage of all mechanism and yet not to have the switches and dimmers too far from the control board. The space allotted for this apparatus consists of a long, narrow strip along the front of the stage pit, and it was decided to place the stage switchboard in the lower story of this pit, two stories below the control board or the proscenium arch. This switchboard is of marbleized slate and has 183 control switches of the Sundh Manufacturing Company's make. Because of the cramped position of the board it was obligatory to put all busbar work on the front, which necessitated lengthening the board to a maximum width of 58 ft.

Each switch on this board has an on and off operation, together with a short-circuiting device which cuts out the dimmers, the latter being effected by means of an additional solenoid in the switch. By means of this short-circuiting arrangement a dimmer may be thrown on or off in an instant. There are 198 switches on the board, an unusual number, and the auditorium

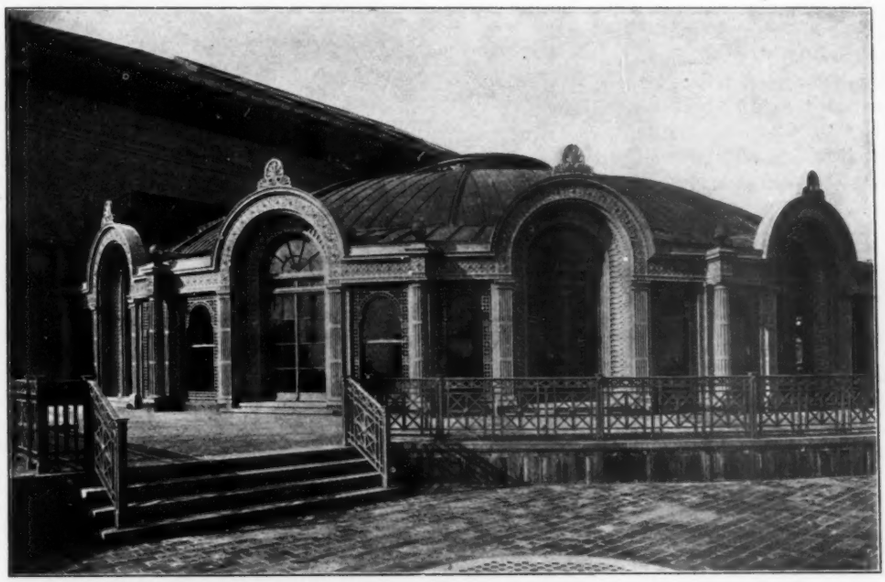


Fig. 12—View of Roof Garden.

lamps alone are connected to 12 dimmers in different sections, as follows: One each for the front boxes, controlling 156 lamps; the rear boxes, controlling 48 lamps; box brackets, controlling 58 lamps; the rear frieze of the first balcony, controlling 70 lamps; the front frieze of the first balcony, controlling 11 lamps; the arch electroliers of the first balcony, controlling 120 lamps; the first balcony circulation, controlling 60 lamps; the second balcony friezes, controlling 81 lamps; the auditorium ceiling, with 236 lamps; proscenium friezes, controlling 56 lamps; auditorium cove No. 1, controlling 126 lamps, and auditorium cove No. 2, controlling 125 lamps. The number of switches exceeds the number of dimmers because the arc lamps and some other miscellaneous portions of the building are not connected to dimmers. For the stage itself there are on this board a very large number of switches. The division of border lamps necessitated 16 individual switches and 16 individual dimmers for each of the eight borders. The footlights are also divided into 16 sections, all of which added to the intricacy of the problem, which was solved by Mr. H. Krantz, of the Krantz Mfg. Co., of Brooklyn, who designed the arrangement.

Fig. 11—General View of the Auditorium from Stage.

The dimmers in the stage pit in the story above the stage switchboard are driven by two 15-hp motors, one driving the forward shaft and the other the reverse shaft. These motors, although each has a separate speed control permitting individual variable speed on the two shafts, may have their forward and reverse shafts geared together so as to run at the same speed. Thus, in case of a breakdown, the disabled motor may be cut out without incapacitating the dimmers. The latter are mounted on one continuous dimmer frame, two abreast, one above and one below, and are driven by gears from the subshafts coupled to the main shafts. The gears from the subshafts to the main shafts are electrically clutched for different speed ratios. Each subshaft has five of these clutches, and there is a total of 28 subshafts. At each of the two motors there are, in addition to the motor-field control, additional gear combinations on the ends of the main shafts, which can be clutched in to give a still wider range of variation.

Each dimmer is arranged to stop at any one of the 15 points which represent the full range of the dimmers. The motion of each individual dimmer is also actuated by electric clutches which cut out at any one of these 15 points. The clutches used in connection with the dimmer frame are actuated by a low-voltage system, operated at about 10 volts or 11 volts, to supply energy for which there are two 4-kw motor-generator sets equipped with throw-over switches arranged so that either motor may be used. The controlling mechanism is as follows: For each dimmer, a limit controller can be set to stop the dimmer at any one of the 15 points throughout its range. A three-way switch operating on the switchboard and representing an on-and-off and a dimmer short-circuit is provided, and for each battery of eight dimmers representing a single color in two borders there is a five-point switch controlling the speed clutches on the dimmer frame. There are also master-limit controllers for each battery of eight dimmers, and master three-way switches for controlling the on-and-off and dimmer short-circuit for

all of the several batteries of eight dimmers. In addition the stage operator has within his reach a master board on which are mounted a master stage switch operating all remote-control switches of the stage section; a master house switch, controlling all the remote-control switches of the house section; a master stage dimmer switch and a master house dimmer switch; one white stage special master switch; one white stage special master dimmer switch; one red stage special master switch; one red stage special master dimmer switch; one blue stage special master switch; one blue stage special master dimmer switch; one amber stage special master switch, and one amber stage special master dimmer switch. There are, moreover, on the master board a control switch and a dimmer switch for each individual color of each individual border and for each individual color of the footlights, and also for each individual color of the strips and pockets.

The complete mechanism makes it possible for the stage operator to control any individual section, turning it on and off, dimming it to any required point at any required speed and in any combination. The extreme time limits at which the dimmers are operated range from two seconds to 15 minutes in passing from full bright to full dim. The arrangements of the master switches and the master dimmer switches make it possible to set the lamps for one scene while another scene is being enacted, it being necessary at the beginning of the next scene only to throw on the master switch and the master dimmer switch.

The wiring used in connection with the low-potential clutch-control circuit is done in parts with lead-sheathed telephone cable and in other parts with No. 16 rubber-covered wire, cabled and taped. To effect the completed arrangement required approximately 12,000 connections of this cable work. The remote-switch circuits are made with standard No. 14 rubber-covered, double-braided wire run in iron conduit.

DISTRIBUTION BOXES.

The distribution boxes are of slate and of the outside-compartment pattern. Because of the complication of feeders it was necessary to put a number of sets of busbars in each box, each set of busbars representing a different feeder. The same distribution boxes are used in some cases for the motor and lamp feeders, although the two systems are kept entirely separate. Throughout the building there are in all 58 distribution boxes, the branch circuiting, for all of which, as well as for the feeders, 30 per cent Para rubber-insulated wire was used, is very elaborate because of the numerous outlets, which are double-circuited and triple-circuited. In addition to the corridor and hall lamps mentioned the usher lamps—that is, the single lamps in the foyers and the fixtures immediately over aisles, which are intended for the benefit of the usher after the auditorium has been darkened—are also thus connected. These lamps are separately controlled and separately dimmed from the others in their respective friezes or fixtures. Further than this, the border lamps around the stage, in the scenery docks, under the stage, in the rigging loft and fly gallery are not only switched at the stage switchboard, but are also wired so that they may be dimmed in cases where dark changes are required.

GENERAL LIGHTING.

The illumination of the auditorium is accomplished by means of a magnificent 300-lamp center chandelier in the form of an inverted cone, with the frosted-ball lamps arranged about it in circles. It is finished in old brass and is suspended by a special hanger, consisting of a pin passing through an eye-bolt. A block is provided in connection with this fixture, by means of which it can be lowered to the floor for cleaning and for the renewal of lamps. The distribution box for the chandelier is set in the dead space immediately above it, and all circuits are arranged with lugs and wing nuts so that they can be readily disconnected when the fixture is lowered. The chandelier is connected to two sub-feeders from the stage switchboard, one-third of the lamps being connected to one feeder and two-thirds to the other. Above the fixture is a large elliptical panel around which is a cove concealing 250 lamps equipped with mirror reflectors of such design as to distribute the light over the panel. The lamps are fed from two feeders and controlled alternately. The mirror reflector is continuous and hinged in sections to fold forward to permit the renewal of lamps from the rear, room having been provided in the dead space over the ceiling to allow of ready access to the reflector.

The orchestra lamps are taken from single-lamp floor plugs set in the floor of the orchestra pit. There are 60 of these plugs, and inasmuch as the orchestra platform may be raised up and down, as before stated, the outlet boxes are connected by means of reinforced, flexible cable to other permanent outlet boxes set in the pit below. There are friezes of lamps set around the back of the ceiling of the balcony and gallery. The lamps are placed in continuous mirror reflectors, which are covered in front with cathedral amber glass. Around the entresol balcony there is a frieze of studded lamps set in outlet boxes with flush covers. Each of these lamps is provided with a cover made up of glass beads. A series of 12 arches of the balcony colonnades, six on either side, are furnished with 20-lamp crystal chandeliers. Each of the boxes is lighted with a single-lamp fixture on each side, and in the center of the ceiling of the anteroom is a two-lamp fixture, one lamp of which

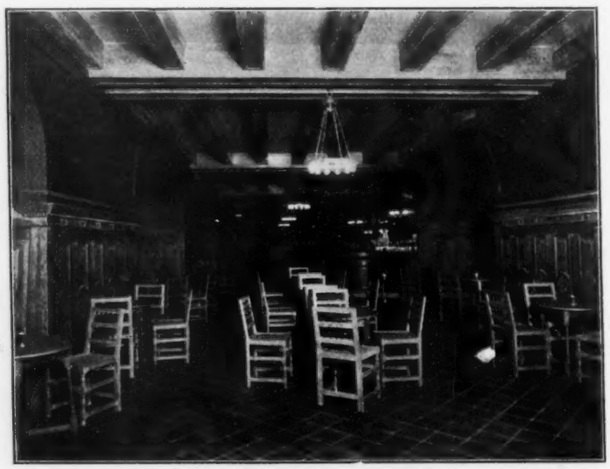


Fig. 13—General View of Cafe.

is connected to the corridor circuit not controlled from the stage switchboard.

The corridors, halls and foyers are lighted by means of chandeliers, while brackets are used on the stairways. The architectural outline of the corridors is such that the ceilings fall into logical divisions, which made the treatment by chandeliers in the center of the panels quite natural. The marquises are lighted by a series of lamp receptacles which are studded on the soffits under the gutters and mounted under brass canopies. The wiring for all this work is done in lead-sheath, rubber-covered wire run in the gutter troughs under the copper gutters, conduit not being used here. Over the billboards, poster boards and above the ticket windows small reflectors and "linolites" are used. These reflectors are mostly made of bronze. In the basement and working sections of the building drop cords for ceiling outlets are largely employed, and key receptacles mounted on outlet boxes are used for the wall lamps.

An elaborate system of lighting was designed for the roof garden inasmuch as this will eventually have a regular stage and be fitted up for the simpler classes of productions. In anticipation of such an arrangement the roof garden was designed to be wired for stage footlights, two borders, strips and pockets. A regular stage switchboard with dimmers will also be provided. As this part of the structure is still unfinished and is only used at present for rehearsals, it is now lighted up by four flaming-arc lamps. Throughout the auditorium, corri-

dors, foyers, circulations and other parts of the building there is a feeder from which base receptacle outlets are wired for lamps used while the structure is being cleaned. From these outlets portables are taken to clusters mounted on tripods. This arrangement makes it necessary to have light only in the portion where the cleaner is occupied, and thus effects a considerable saving in the amount of energy used.

The system of lighting on the dressing tables in the various

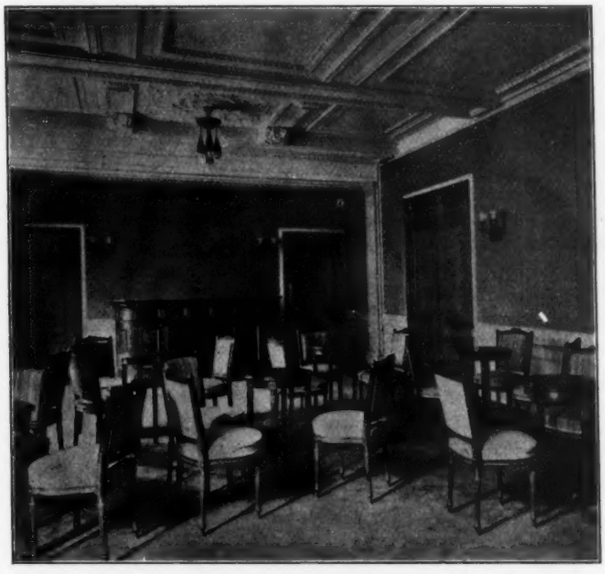


Fig. 14—Corner of Tea Room.

principals' dressing-rooms, of which there are 37, consists of a lamp and reflector over the mirror, lamps and reflectors at each side of the mirror, electric curling iron and grease-paint heater, all controlled by switches on the side of the table. These dressing tables are quite elaborate affairs, comprising a table in the center, with a mirror above and a large wardrobe on either side, the doors of which are fitted with full-length mirrors which may be opened back to form a triple mirror. The heaters, as well as the reflectors, are permanently attached to the table. All of the wiring of the entire table is enclosed in conduit, and in order that the table may be lifted out for cleaning purposes, etc., the lamps, etc., are fed from wall receptacles. The chorus dressing-rooms are lighted with single-reflector brackets over each table, while in the costume-rooms, sewing-rooms, etc., there is a line of mirror reflectors running the length of the ceiling and hung in the center of the room directly above the main costume table.

STAGE LIGHTING.

As above mentioned, the footlights are wired in four colors and in four sections across the stage. For this purpose 16-cp "linolites," made by the H. W. Johns-Manville Company, were employed, set vertically against an enameled sheet-steel reflector, the latter hinged in sections so that it will fold forward into the footlight gutter, permitting the Shakespearean stage to extend right over them. There are 386 lamps in the footlights and the line is interrupted by the two hoods, the prompter's and that for the operator of the stage switchboard.

There is a total of 432 border lamps, made up of 16-cp "linolites" in four colors. There are four sections of each color arranged across the stage, the effect of such a division making it possible to obtain a light gradation from darkness to full brilliancy not only from one side of the stage to the other, but from the back to the front of the stage as well. There will eventually be eight borders, although at present only five are installed. The borders are constructed with a working bridge above, each with hand rails, forming a part of the border. These bridges are used for the operation of the spot lamps and the end sections of the borders under the bridges are hinged so that while the center remains straight, the under sections may be let down. The distribution boxes for the border incandescent lamps, as well as for the border arc lamps, are mounted on the gridiron. The border cables drop from the gridiron and have large counterweighted wood sheath take-ups. Arrangements are made on the border bridges for eight 50-amp arc pockets, and the cables for the arc pockets are connected with the bridge in the same way as are the other cables. In addition to the bridge pockets, there are pockets on each side of the stage for each of the eight entrances. In the floor of each of these entrances are mounted two 50-amp arc pockets and four pockets for incandescent lamps. The boxes for these arc pockets and incandescent pockets are set in the basement at the side of the stage, the incandescent pockets being also connected to dimmers.

The pockets used in the theater are of an unusual pattern, the invention of Mr. Claude L. Hagen, the technical director of the New Theater. Each receptacle is attached to the end of a piece of stage cable 50 ft. in length, the other end of the cable being attached to the outlet box. When not in use the receptacle drops down and comes flush with the stage, the cable looping into the clear space below in the stage basement. The arrangement is quite similar to that employed in connection with the plugs in telephone switchboards with the exception that there is no weight attached to the cable, which is sufficiently heavy to pull the receptacle back into place. By this means there is no cable not in use left on the stage. All the arc lamps used on the stage have fixed arc-lamp resistances mounted independently of the base of the lamps and ahead of the receptacles. The arc lamps are of the same rating so that the fixed resistances fit all lamps. This arrangement is quite convenient, inasmuch as the lamps, being so much lighter without the resistances, are more easily moved from place to place.

LOW POTENTIAL SYSTEM.

There is installed in the theater a complete fire-alarm system with stations mounted throughout the auditorium and stage, installed and maintained by the American District Telegraph

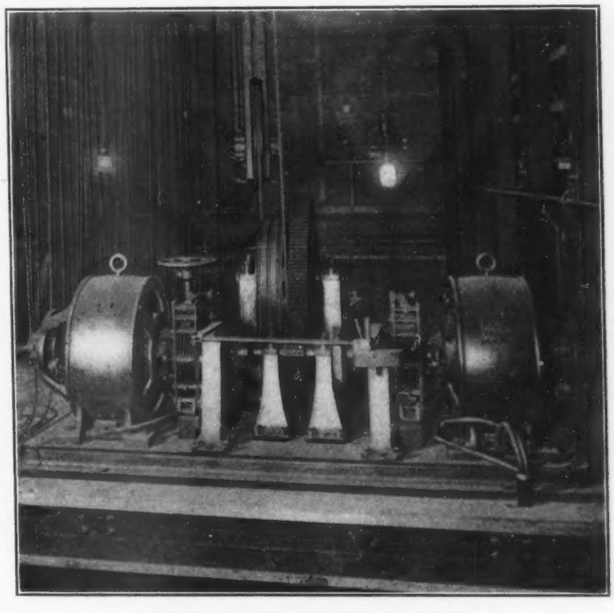


Fig. 15—Apparatus for Turning Stage.

Company, and an elaborate system of bells and buzzers for signaling from the stage manager's and theatrical director's stands. At these two points, at the right and left of the proscenium arch, are large signal boards arranged for the stage manager and theatrical director, respectively. These are equipped with buzzers, pushes, fire-alarm clocks, signals and curtain-operating devices used in connection with the various productions. There is a system of entr'acte bells which ring

intermittently before the curtain rises at various places throughout the corridors, foyers, buffet, etc. There is also an entr'acte indicator mounted in the center of the proscenium arch, which indicates the length of the intermission. This consists of an electric carriage call monogram mounted behind translucent glass colored to match the scagliola of the proscenium arch. At the ends of the dressing-room corridors, in the greenroom and in the manager's office there are electric lamp annunciators.

Distributed throughout the auditorium is a system of electric acousticons with receptacles on the chairs and transmitters mounted one in the center of the footlights and one on each side of the proscenium arch. There are switches for this system on the stage manager's board by means of which different combinations of transmitters may be thrown in and regulated so as to obtain the best results. The system is also supplied with a receptacle for a receiver in the greenroom and in the manager's office. In addition to the system of public and house telephones and one or two small intercommunicating systems there is a stage operating telephone system, consisting of 30 jacks mounted at various locations on the stage, fly galleries, rigging lofts, etc., and interconnected so as to give communication with the stage manager and the technical director. At all the stations in this system there is located a bull's-eye flash lamp operated either from the technical director's or stage manager's board. These flash lamps are also used for giving cues.

The scene shifters and other stage operators are provided with a head receiver and chest transmitter attached to a cord which terminates in a plug. When the stage director signals by means of the flash lamps the operators plug in their telephone sets at the nearest receptacles and the particular operator to whom the instructions are addressed can reply through his chest transmitter so that the stage manager will know that his orders have been properly received. Instructions for this stage system can be given either from the stage managers' booths or from the prompter's station.

There are also a number of miscellaneous flash-lamp indicators and signals used in connection with the stage operations and with productions. Nearly all these signals are connected to the 10-volt system, but the more vital ones, such as fire-curtain signals, etc., are made up of two or three 110-volt lamps set in parallel and controlled by three-point switches. The energy for the low-potential service, except the telephone talking service, is generated by a 3-kw, 10-volt motor-generator set located in the engine-room. Over this set is a low-potential switchboard with all the distribution switches. A storage battery is also used in connection with this system.

The telephone is also employed in connection with the electric carriage call system. An attendant located in the lobby is equipped with a head receiver and chest transmitter which is attached to a line terminating in a plug receptacle on the outside of the building near the front entrance. Another attendant at the termination of the performance is stationed outside the building and provided with a hand telephone set which is plugged into the line connecting with the attendant in the lobby. As the patrons of the theater come out into the lobby, the attendant there telephones the information to the man located on the outside, who in turn issues the necessary information to bring the right carriage or automobile to the entrance. Besides the above systems, the stage manager has a line on a separate system to the green room, and there is a telephone line between the rehearsal room and the roof garden.

As a whole, the building is regarded as one worthy of the new organization which it represents. Messrs. Carrère & Hastings, of New York, were the architects of the structure, which is of the modern French type, the general outline of the exterior and all the details of the interior finish fitting perfectly into the harmonious whole. The general contractors for the building were Messrs. Marc Eidlitz & Son, and the consulting engineers into whose hands fell the task of planning the elaborate electrical work were Messrs. Patterson Brothers. The contractor for the entire electrical wiring and equipment was the Western Electric Company, and the lighting fixtures were designed by Messrs. Edward L. Caldwell & Company.

NORTHERN CONNECTICUT LIGHT & POWER CO.

An Example of Plant Consolidation and District Distribution.

THE Northern Connecticut Light & Power Company, of Windsor Locks, Conn., is a consolidation of the Windsor Locks Electric Lighting Company, the Enfield Electric Light & Power Company, of Thompsonville, and the Enfield Gas Company. The consolidation took place about three years ago, up to which time the Enfield Electric Light & Power Company operated a station at Thompsonville and supplied direct current to the territory near the station and 133-cycle alternating current to the outlying district, besides a series-arc circuit. The direct-current machines were steam driven and the alternators were driven by water-power from the canal of the Connecticut River Company. After the consolidation the Windsor Locks station was entirely rebuilt, the plant at Thompsonville shut down and the building used as a substation, and a 6600-volt transmission line built from Windsor Locks.

The territory at present supplied from Windsor Locks is contiguous to both sides of the Connecticut River between Hartford, Conn., and Springfield, Mass., a distance of about 20 miles, and also extends to Hazardville and Broad Brook, five

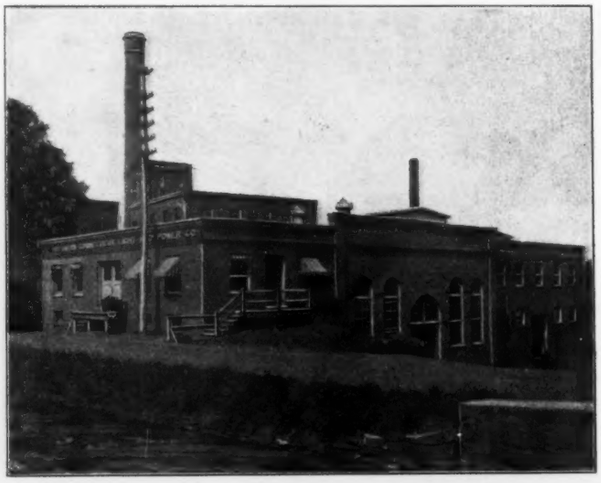


Fig. 1—Station of the Northern Connecticut Light & Power Company.

miles east of the river. The towns and villages served embrace Thompsonville, Windsor Locks, Hazardville, Warehouse Point, Broad Brook and South Windsor, having a population aggregating 22,000.

The main generating station is located at the lower end of the canal in Windsor Locks. A modern brick and concrete structure houses the following generating equipment: One 200-hp Hanover water-wheel with Lombard governor, the wheel being direct-connected to a 180-kw, 2300-volt, three-phase Crocker-Wheeler generator; one 325-hp Allis-Chalmers Corliss engine belted to a 200-kw, 2300-volt, three-phase Bullock generator; one 300-hp cross-compound Ball engine belted to a 165-kw, 2300-volt, three-phase Crocker-Wheeler generator; one 250-hp Erie engine belted to a 135-kw, 2300-volt, three-phase Stanley inductor generator; three 150-hp Bigelow return-tubular boilers and two barometric condensers. A steam-driven blower is used to supply forced draft under the boiler grates in place of an expensive stack; the boilers being used only a few hours each day at the time of peak load.

The switchboard is made up of blue Vermont marble and contains four exciter panels, four generator panels, one transmission panel, one local totalizing panel, three commercial lighting and power panels, and one street-lighting panel. For stepping up the potential for the circuit to Thompsonville three 75-kw Crocker-Wheeler 2300-6600-volt transformers are installed. The length of the transmission line is 6.5 miles, and it

follows the highways on 35-ft. and 40-ft. poles. No. 4 bare-copper wire is employed on this line and porcelain insulators. A 2300-volt circuit runs five miles east of the plant to Broad Brook, and another runs five miles from the Thompsonville substation to Hazardville. The three-wire distributing system in Thompsonville is divided into three sections fed by five 25-kw transformers with pressure wires leading from the ends of the three-wire feeders to voltmeters at the substation.

The power-house staff consists of four men and one switchboard attendant is required at the Thompsonville substation. The line work of the entire territory is handled from Windsor Locks and requires the attention of four men, one of whom also takes the monthly reading of all meters and makes periodic meter tests as well, all meters being tested yearly. The total number of meters in use on Nov. 1 was 521.

Three years ago, under the old management and separate companies, the territory was wholly unexploited in a commercial way, there being no day service and consequently no motor load. The lighting load was also of an indefinite character. The reconstruction of the station and system was practically completed a year ago, when a change of management took place. Under the present management, the year ending Nov. 30, 1909, shows an increase of about 35 per cent in gross earnings, while the net earnings are nearly 60 per cent over those of the corresponding period of the previous year.

About 100 customers who were still on a flat-rate basis were provided with meters last May, and at the same time a reduction was made in the maximum rate from 18 cents to 15 cents per kw-hour in the territory formerly supplied by the Enfield Electric Light & Power Company, and a reduction in the minimum rate to $1 per month all the year round was made in the territory formerly served by the Windsor Locks Electric Lighting Company, thus establishing a uniform rate throughout the entire territory fed by the company. Carbon-filament lamps were replaced by tungsten-filament lamps and other changes made for the good of the service. During the months of April and May, 50 flatirons were loaned out with the privilege of being returned if the customers so desired after a 30-days' trial, and only two irons were returned.

Last October two lectures on scientific and economical lighting were given by an illuminating engineer under the auspices of the company, for which personal invitations were sent to all customers and prospective customers with profit to the company. At the present time the company is engaged in a special house-wiring campaign from which good results are expected. The company offers to wire houses located on its lines with seven outlets and 10 tungsten lamps complete with shades and fixtures and with the wires concealed as far as practicable for $40. The outlets will be located as follows: A three-lamp fixture in the parlor; a two-lamp fixture in the dining-room; a ceiling fixture in the first-floor hall; a ceiling rosette, with switch, on the porch; a drop lamp in the kitchen and a bracket lamp in each of two bedrooms. The bedrooms must be located directly above the rooms wired on the first floor or the price will be increased. The price specified calls for payment within 10 days after the completion of the work; but, if desired, the customer can pay in easy monthly instalments, when the cost is $45. One man devotes all his time to canvassing for new business and during the past year 167 hp in motors were connected to the company's circuits. The prospects for increased motor load are very bright.

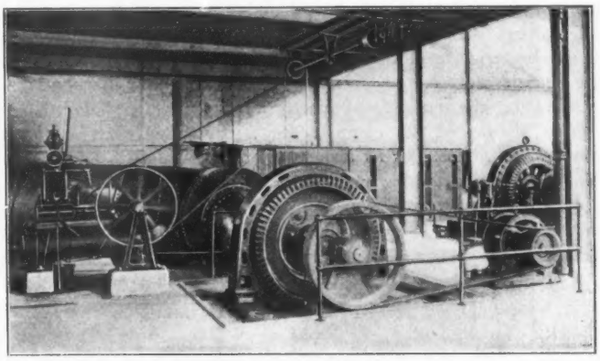


Fig. 3—Water-Driven Alternator

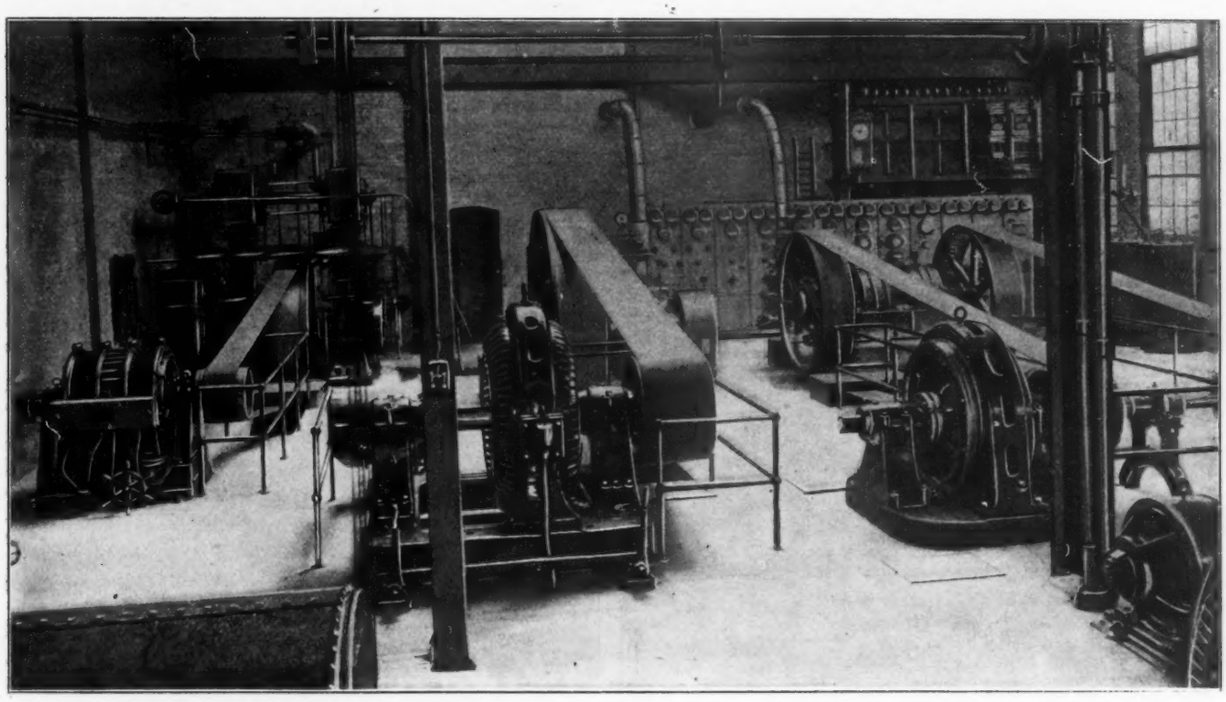


Fig. 2—General View of the Generating Equipment in Windsor Locks Station.

A showroom and office are maintained in Thompsonville near the business center of the town, while the executive office of the company is maintained in Windsor Locks in connection with the generating station. The management believes in a liberal public policy, and everything possible is done to win the

good will of the public toward the company. The connected load on Dec. 1 was as follows: Commercial lighting 10,935 16-cp equivalents, 352 hp in motors, 26 series-arc lamps, 477 25-cp series-tungsten lamps and 57 25-cp multiple-incandescent lamps.

The base rate for energy for lamps is 15 cents per kw-hour with quantity discounts ranging up to 40 per cent; all bills being subject to a 10 per cent discount for prompt payment. The rate for motor circuits is 10 cents for the first 20 hours' use per month of the connected load and 3 cents per kw-hour for all energy used in excess. To large consumers who supply their own transformers 2300-volt current is sold at 3 cents per kw-hour irrespective of the monthly demand, less a discount, depending on the quantity of electricity consumed per month.

The officers of the company are: President, Mr. William Mather, Windsor Locks; treasurer, Mr. Burdett Loomis, Jr., Hartford; assistant treasurer, Mr. Stewart N. Dunning, Hartford; secretary, Mr. Harrison B. Freeman, Jr., Hartford; general manager and superintendent, Mr. Walter P. Schwabe, Windsor Locks.

ELECTRICITY ON THE FARM.

European Applications of Electric Power to Agricultural Operations.

THE concentration of individuals in commercial centers and other large communities, due to the attractions of city life and also the better education of our farmers' sons, and, consequently, the possibility of success in pursuits which force them to locate in cities, makes it more difficult each year to secure sufficient labor for carrying on farming operations, whether it be on a small or on a large scale.

The problem to be solved, therefore, is what to substitute in the way of motor-driven machinery for manual or animal labor. The attendance of the numerous individuals necessary in connection with animal-power devices eliminates this kind of power from the proposition.

The mechanical means originally employed as substitutes for manual and animal power were wind mills, waterwheels, steam engines, gas and hot-air engines, etc. This practice very materially complicates the operation of farming implements and

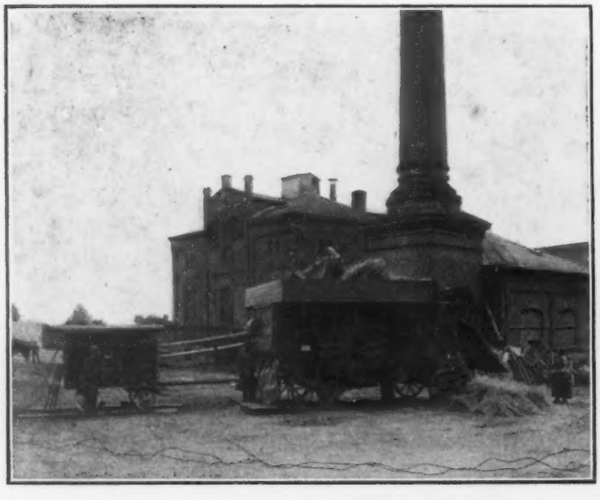


Fig. 1—Electrically Operated Threshing Machine.

machinery because of the necessity of the introduction in their operation of long lines of shafting, numerous pulleys and belts and other machinery for the transmission of this power; furthermore, the greatest disadvantage in the use of these lies in the fact that such power can be profitably utilized over only a very much restricted area, and it is, therefore, usually concentrated within a small radius of the point where power is generated. It is, therefore, quite evident that mechanical power will not properly serve for the economical operation of the farms of the future as its distribution requires too complicated and expensive mechanism; plowing, sowing, reaping, etc., being practically impossible with such mechanical power generated at a central point.

The only system which has proved to lend itself favorably to the proper and economical generation, distribution and utilization of power for agricultural purposes of all kinds is electricity.

Portable engines, which had been used for superseding animal power, for plowing, threshing and other agricultural needs,

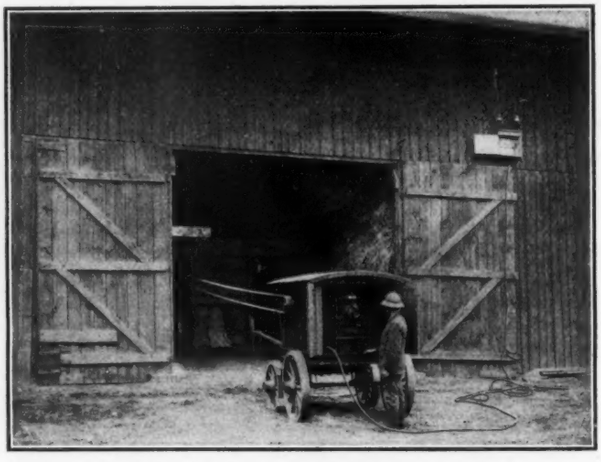


Fig. 2—One Application of Electric Power on the Farm.

are not satisfactory from an economical standpoint because fuel and water must be supplied at too great distances out in the fields. A further serious disadvantage is the necessity of transporting machines of great weight over hilly country and soft lands, conditions in some cases being absolutely prohibitive so far as concerns the transporting of such apparatus to the point of use.

On the other hand, the advantages accruing from the use of electricity are apparent at first glance, as the energy may be easily and economically distributed over large tracts of land by feeders strung over the entire area, and may at any point be

Fig. 3—Electrically Operated Dairy Appliances.

readily utilized in either motors, lamps or on heaters, since the light electric motors can easily and swiftly be transported over any kind of soil.

The advantage of cleanliness and convenience of electricity is well understood. Another decided advantage of the electrical system is that the energy may be drawn from a central point on the farm or ranch, or where this is not practicable it may be drawn from the nearest town or from the plant of a public-service company. If this farm is of large proportions and the

rate of consumption of energy runs up into many horse-power, or if the location is far distant from any outside source of supply, it will even pay to install a private plant for generating the electric energy. In such cases water-power would be of great service, but where such natural resources are not at hand a steam, gas or oil-engine plant for generating the energy may be installed, the exact type to be chosen depending upon loca-

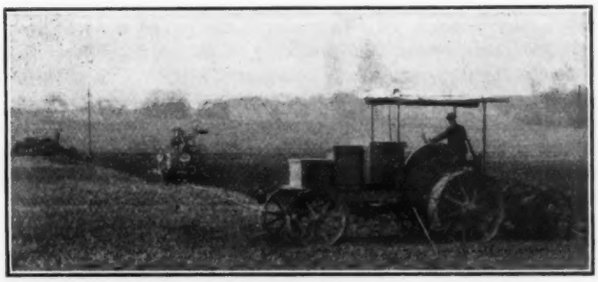


Fig. 4—Plowing a Field.

tion conditions, as they may influence the cost of fuel, installation, etc.

Of recent years the improvements in gas and oil-engines, and also batteries for the storage of electricity and their simplification, have caused these to compare most favorably with the other high-class and large-power producing machinery so far as first cost, operation and reliability are concerned, so that even the smaller farms can use this class of service to great advantage. The economy and convenience arising from this combination is due to the possibility of generating energy at any time, and when little power is required, and storing it by means of such storage apparatus, the reserve energy being utilized when the demand is large, thereby assisting the generators, or when the generators are shut down, as, for instance, at night

Fig. 5—Transmission Line on a Farm.

when electricity may be used for lighting and other purposes.

There are numerous small water-powers scattered all over the country which remain undeveloped or have been abandoned, being probably too small to serve economically for industrial undertakings, which might be cheaply developed for agricultural use. If such power is of sufficient size it might be used to supply electricity for a number of farms, so that the individual consumer could derive energy therefrom at a small cost.

The tendency in America at present is to utilize the large water-power, and to install mammoth central stations from which electrical energy is distributed over great areas forming a radius of 200 miles or more from the central station. The energy of Niagara, for instance, is delivered as far as Syracuse on the American side, about 165 miles away, and transmission lines are now being installed to deliver energy on the Canadian side as far as London and Windsor, this line having a total length of about 300 miles.

What has been done in the application of electricity in the agricultural field, particularly in Germany, where the proprietors of large farms have been brought to appreciate the advantages of this system, may be seen from the illustrations given herewith, representing methods and devices in use there for some years.

So far as the use of agricultural machines themselves was concerned, Germany early recognized that Americans were far ahead of all countries due to the practical applications of new ideas. Consequently, at that time, about 15 years ago, German engineers were sent to this country, supported by the German Government and manufacturers, for the purpose of investigating such machinery, particularly those in use on the great Western ranches, and to-day Germany is far ahead of all nations in the application of electricity for agricultural purposes; the superiority of the German appliances extends not only to powerful electrically driven plows, but down to the smaller machines, such as dairy appliances and poultry-raising devices. Some of the largest and most prominent electrical manufacturing concerns in Germany have entered this field and are supplying such machinery on an extensive scale.

One of the most important applications of electricity in the agricultural field is that of the electrical plow, the design and operation of which is a radical departure from the steam plow, as shown by the twin-machine system in which two machines are employed, one on each side of the field, alternately pulling the plowing device across the field by means of a cable. The

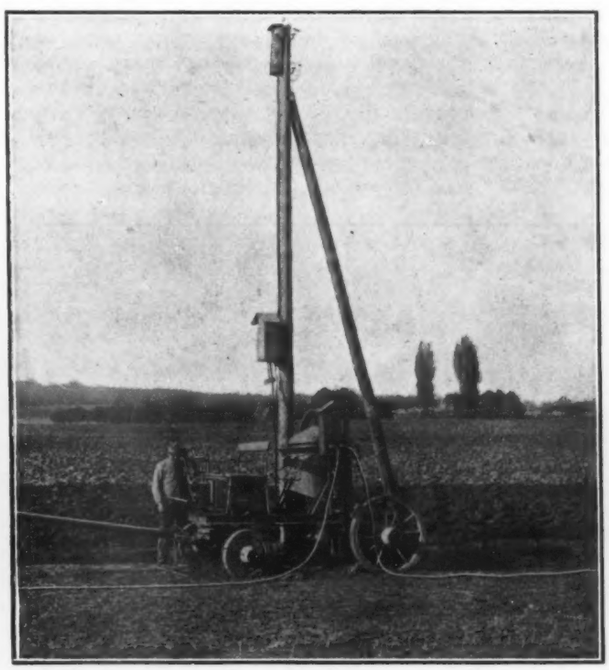


Fig. 6—Portable Transformer with Telephone Connection.

electrical energy for the motors, one on each of the twin-machines, is supplied by distributing lines arranged on poles along the field, flexible cable connections being utilized between these distributing wires and the motors.

In the single-machine system use is made of only one machine, located on one side of the field, and an anchor wagon for supporting the cable sheaves is located on the other side of the field. The plowing device, which is attached to an end-

less cable and is reversible, is pulled across the field in both directions by the one machine, the anchor wagon being also automatically moved along to a new furrow, as the plowing proceeds, parallel with the machine itself. The first trials of these plowing machines were made in 1902 on a 65-acre field of a German estate, and at present many such machines, of different designs, are in operation in Germany.

The energy supplied to these motors may be drawn from collecting devices arranged on poles at convenient intervals and which collecting devices may be easily removed from one

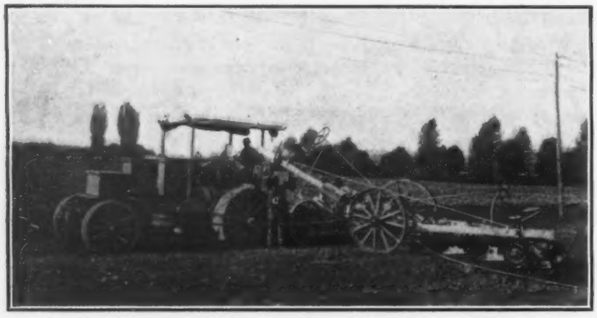


Fig. 7—Starting a New Furrow in Ploughing.

pole to another, although this is not frequently required to be done as the plowing machine carries an energy-feeding cable from 1500 ft. to 3000 ft. in length.

The transformers for reducing the electrical voltage are sometimes mounted on towers conveniently located in the barnyard, and are sometimes made portable by mounting them on a separate wagon which may be transported to any point of the farm or to a neighboring farm.

The cost for plowing on a farm of about 300 acres, and with energy supplied from a central station, is about $2 per acre.

The power required for drawing one of these electrically operated plows depends, of course, upon the local requirements, such as the depth of the furrows and the speed, while the character of the soil and the number of shares per plow also enter as a factor. A large-size machine of complete equipment will require from 30 hp to 50 hp, and costs from $8,000 to $12,000. When proper judgment is used in selecting a machine appropriate for the work to be done it has been found to be a good investment. Of course, a number of farm-

Fig. 8—Transformer Tower in a German Barn Yard.

ers in one locality can make use of a single machine, so that the cost per farm is proportionately reduced.

In an electrically operated threshing machine the motor is mounted on a separate wagon, so that it may be used for any number of machines. These motors vary in rating from 5 hp to 15 hp, and can be readily transported to any point on the farm or to other farms if desirable.

Other applications of electric motors for agricultural purposes are for reaping machines, mowing machines, planters or sowing machines, besides the many smaller machines used on a farm and in a dairy, such as churns, butter workers, pasteurizing apparatus, various grinding machines and feed cutters, for operating pumps, cream beaters, cow-milkers, horse-clipping and sheep-shearing appliances, and sewing machines, laundry machinery, and for supplying heat for ironing and for incubators, as well as lighting the barns and various farm buildings.

The extent to which electricity is utilized for agricultural purposes in Germany is evidenced by the amount of apparatus supplied by a single manufacturing concern for a small area in Pommerania, comprising a number of farms, the motors aggregating about 2000 hp, the incandescent electric lamps aggregating 22,000, besides about 150 arc lamps, the energy being supplied from several small plants located on these farms, comprising 60 stationary and 15 portable steam engines, 18 waterwheels and 10 gas and alcohol engines for driving the electrical generators.

The tendency in Germany, which no doubt will be followed in this country, is to supply the energy to the various farms from large central stations located near the natural resources. For instance, at Vangerow-Breitenfelde, Germany, there is a co-operative cross-country central plant and transmission system installed especially for agricultural purposes. It has 65 miles of transmission line, the furthest point of distribution being about 22 miles distant, and it serves about 35 farms. Similar installations are found in other parts of Germany, particularly in the Rheinland, Westphalia and Bavaria.

It must also be borne in mind, however, that for smaller installations, with individual plants, the farmer may produce his own fuel by making alcohol from potatoes raised on the farm, which by modern processes can be made cheaply, and can be conveniently handled and used through modern engineering methods as a fuel for internal-combustion engines.

GAS-ENGINE ALTERNATORS IN PARALLEL.

Observations and Conclusions from Their Practical Operation.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

In the design of a gas engine the whole aim should be to get a close and prompt connection between the driving forces of the gas and the load. The former is a series of explosions, lighter or heavier according to the amount admitted by the governor. When the load decreases suddenly and the governor still permits three or four heavy explosions, the engine will start to race in consequence, and, if its alternator is in parallel with two or more other alternators, it must take them electrically with it. As, mechanically, the other machines must lag behind the "fast" one, there are "cross-currents" on the ammeters and surging within fixed limits, since this gain in speed will cause the governor to close the ports and keep them closed several strokes too much, thus making it drag behind the other machines. This action is made manifest in the swinging of the ammeter and wattmeter needles which has been an invariable characteristic of the many gas plants which have come under the writer's observation.

An analysis of the above-mentioned swinging will show it to be entirely a matter of speed variation. It may, or may not, be in synchronism with the revolutions of the engines; in some plants the swing is every two revolutions; in others it has nothing in common with the revolutions; in most plants it corresponds exactly with them. An extreme case exists when two three-phase machines are thrown in parallel exactly one phase apart. It may be remarked that there has been installed by a New York consulting engineer a certain plant where the synchronoscope transformer of one machine is on the "A" phase and that of the other on the "B" phase. To this day the poor deluded operators still take the utmost care in slamming in the switch with the greatest precision just as the lamp becomes dim, whereat the lamp immediately jumps to one-third brilliancy and stays so. All of the four 400-kw gas engines in the

plant leap into tremendous convulsions with incessant misfires and backfiring, while the instrument needles go wild. Both of the wattmeter and ammeter needles swing from 0 to the top of the range, which is 600 kw, striking the stop pin at every swing. If two people count readings simultaneously it will be found that when one calls "right," the other will be calling "left" (and this is also true with the ordinary periodic swinging), showing that as one machine is taking the load the other is dropping it.

It may be well to study these data somewhat. In the first place, the machines are in phase, and became so immediately the switch was thrown, because the lamp remained at one-third brilliancy throughout the whole commotion. One machine forced the other to jump into phase with itself the instant the switch was closed and connected them. That this is true one can readily convince himself by throwing in phase carelessly a belted and directly connected alternator and noting the shriek of the belt if the lamp is not dark. Therefore, since they are still in phase, the violent swinging of the needles cannot be due to both machines being completely out of phase and searching for the true position of synchronism, as has often been argued. To get the true explanation one must consider the simple case of two identical steam engines in parallel where one has more driving power than the other. For instance, one may have lost most of its piston rings or its governor springs may have become weakened or loose. In neither case will the two engines divide the load equally. In the one case the weak engine will only take a certain amount and the other will have to carry all the rest, no matter how much load is put on. In the second case the two engines will equalize as soon as the speed drops sufficiently for the one with the weak governor springs to open to full cut-off.

The power-house men call the stronger engine the "fast" one—and with reason, though, of course, both engines are of identical speed, being in parallel—for, as a matter of fact, the "strong" engine is a trifle "fast," being just enough leading in phase position to take the heavy load it does at that speed. When weakened ever so little it must drop off some load or some speed, and as it cannot drop the latter, the load falls off. When the throttle is partly closed, it will still run in parallel delivering only 50 kw, say, while the other one may be carrying 300 kw. Being now the "slow" machine, it always lags in position just behind the other; it cannot pass it or even equal it because it does not get gas enough to produce the desired speed and power to come abreast of the other engine.

The speed of the engines may be compared to the speed of a car pushed by two equal-sized springs. If both have impressed the same force, they will compress equally and divide the load between them, equivalent to both engines occupying the same position in the phase. If one has only a light force back of it, its end will lag back and the end of the other must be advanced correspondingly to compress it sufficiently to take the balance of the load. In the same way one engine falls behind the other in phase position on lightening the driving power, and advances with heavier power, thus assuming more load. Now, the surging of two engines in parallel on the load is precisely like the action of the springs carrying the load between them, and they are giving and taking within the limits of a single phase so that the instrument needles show first one, then the other, assuming the whole or the major part of the load. The speed in r.p.m. remains the same, corresponding to the car going ahead at full speed, and the two engines being similar to the two springs in transmitting the driving force. If one of two engines in parallel is yanked forcibly ahead or astern the distance of one phase on the stator, it goes without saying there must be violent oscillations between the yanker and the yanked. The heavy mass of the flywheel and rotor will come, because it has to, but certainly not with the docility of a 2-milligramme dead-beat galvanometer needle. The two engines have nothing but powerful magnetic forces to hold them to the correct position, and they, therefore, give and take on the load, oscillating on either side of the true position until they settle down at the same point in the phase and divide the load equally.

The ordinary periodic swinging of the instrument needles shows the same phenomenon, being caused by lack of connection between the governor and the load. Several years ago the writer determined to study at first hand the oscillations of engines in parallel with a view to learn something of the actual amplitude of such oscillations in per cent of the speed. It was some time before a suitable tachometer came to hand, but that designed by Dr. Horn, of Syracuse, proved to possess the necessary sensitiveness. This little instrument reads up to 3200 r.p.m. in four stages. It has a single needle, which takes its position on the dial due to a rack movement connected to two tiny centrifugal balls driven by the shaft, which can be connected to the motor or engine, the speed of which is to be measured, by a steel center-drift, or a wheel, or by a rubber cone.

As the balls are positively driven, and their own inertia has no effect whatever on the needle, the minutest variations in speed are faithfully indicated by the tachometer. It will show, for instance, even such a detail as the belt lacing of a motor belt passing over the pulley or a knock in an ordinary steam engine.

An induction motor driving a steady load has almost absolute uniformity of speed, the only point of variation shown by the tachometer being when the belt lacing passes over the pulley, whereat the latter jumps ahead by about one part in 750. When a small steam engine drives a steady shop load, its rotation shows also very uniform, as the immense inertia of all the shafting and tools in the shop takes up all the incessant small variations of the throttle governor. However, when the same engine drives a sensitive load, such as a large blast fan, there are periodic disturbances in unison with the opening and closing of the throttle governor, as shown by a violent twitching of the needle with an amplitude of from 8 to 16 in 250 on either side of the mean revolutions. These changes occur about once every four seconds.

Readings taken from two 300-kw, 25-cycle, three-phase alternators in parallel, driven by compound marine engines with Rites flywheel governors, show periodic variations, in unison with the revolutions, of less than one part in 250, and the instruments on the board are entirely steady and the paralleling perfect. Originally these engines had only one governor spring, and, as the weight could not be reduced because of the inertia of the valve mechanism, the governors were sluggish and feeble. The tachometer then showed angular variation with one spring of from 8 to 25 parts in 250, and the paralleling was wild. By putting on a second spring the same engines gave a variation of less than one part in 250.

In a certain case two Harrisburg engines, with Rites governors, driving two 60-cycle, three-phase alternators in parallel, showed from 1 to 1.5 parts in 276 periodic variation in unison with the revolutions, and the paralleling in this plant was absolutely perfect, positively no swinging of the needles being discernible.

In another case two three-cylinder vertical gas engines driving 250-kw, 60-cycle, three-phase alternators showed an angular variation of from 8 to 12 parts in 240. The paralleling was poor and uncertain, and the swinging of the instrument needles incessant over a considerable range. With certain two 360-kw, three-phase, 25-cycle alternators the speed variation was about four parts in 150, the instrument needles uncertain and swinging considerably. With one 500-kw, three-phase, 60-cycle alternator showing less than one part in 187 variation the instruments were steady and when put in parallel with other engines which were showing considerable hunting it quieted them down to a minimum.

In another plant, in which, however, no tachometer observations were taken, were two 360-kw, 60-cycle, three-phase gas-driven alternators. The wattmeter readings ranged from about 165 kw to 235 kw, with corresponding swinging of the ammeter needles. The mean load carried was less than 200 kw, but under no consideration would the operators dare to put all of the load, amounting to about 380 kw, on one engine.

In all of the above gas-engine cases the amplitude of swing

varied incessantly and periodically. It would become less and less until the instruments were almost quiet at load point and then suddenly jump to maximum and again dwindle, the cycle of variation recurring about every six seconds.

In analyzing the indications of the tachometer it is noticeable at the outset that when any engine runs steadily enough by itself under load to show less than one part in 250 speed variation, it will parallel smoothly and without hunting. Furthermore, the more nearly the governor approaches the practically instantaneous dead-beat control of the flywheel type of governor, the smaller will be the per cent of variation. Of course, the flywheel weight does not enter this discussion, it having been proportioned so as to take care of all the inertia of the moving parts, leaving the governor free to deal with the load alone.

The next indications to study would be those of the two 250-kw vertical gas engines, showing a speed variation of from 8 to 12 in 240. That is to say, the tachometer needle varied periodically all the way from 232 r.p.m. to 248 r.p.m., 240 r.p.m. being the mean position and the one occupied by the needle during the greater part of the revolutions. Now, as these variations often take place during a single revolution, it is obvious that the actual number of revolutions per minute does not vary appreciably, but that the rate of rotation is not uniform, though it averages properly. At one instant it may be turning at the rate of 232 r.p.m., the next 238 r.p.m., the next 242 r.p.m., the next 246 r.p.m. and back again, all in the time of one or two complete turns of the flywheel. However, as the alternators are in parallel, the actual amplitude of these variations must be entirely within the limits of one phase, say, two slots of the stator. It follows that the greater these variations the greater will be the oscillation of the engines under load and the greater the swing of the instrument needles—the spring compressing and relaxing, as it were, in proportion to the driving power represented by the indicated speed variations.

There remains only to be considered the effect of the above-mentioned variations on the electric dampers on the pole-pieces of the field cores. According to Dr. Charles P. Steinmetz, the squirrel-cage type of damper is the best because it always lags behind any change of rotation. As the speed varies, the frequency varies also. Now, as the tachometer shows, in a poorly governed engine, constant variation in the rate of rotation, limited only by the magnetic forces which hold the engines in parallel, the dampers of both engines are constantly under the play of these varying frequencies, and as the damper is always opposed to any changes of frequency its steadying effect is very powerful. It has been urged that the squirrel-cage damper cannot be compared in this way to the slip of the rotor of an induction motor because the damper is a synchronous piece of apparatus. True, it is in synchronism with its own flywheel and varies up and down with it, but it is by no means in synchronism with the variations of the other machine to which variations it is subject electrically. The rotor of a large induction motor will develop its full torque with about 3 per cent slip; in other words, if both it and the rotating field in the stator are moving along at synchronism under no-load and the rate of the field rotation suddenly raises 3 per cent it will develop the full torque in the rotor, though the latter may not be able to advance a fraction beyond its synchronous position. This is exactly what happens to the squirrel-cage damper under the play of varying frequencies. It cannot change its own position appreciably, but it can and does develop the full force of its torque, opposing the tendency of both engines to change their speed from the mean.

It follows, then, that, for maximum anti-hunting effect, the damper design which approaches nearest the ideal induction-rotor design, under the limits imposed by due considerations of good dynamo efficiency, will give the best results, and is especially needed in gas engines, where the governing is none too perfect and the driving force is a series of explosions subject to the constant variations of the composition of the gas itself.

The Standard Oil Company recently purchased for the Bay Way Refinery some 750-hp, 167-r.p.m., horizontal, two-cylinder, four-cycle, side-crank gas engines directly connected to engine-type, 700-kva alternators designed for 480 volts, three-phase, 25-cycles.

In general design the Bethlehem engines differ but little from the accepted type of large horizontal gas engines, but in specific details there are many points of interest. The cylinders and pistons are of cast steel throughout. This construction enables one to get thin walls with good heat transfer to the jacket water, and strong, tough castings not at all subject to temperature and expansion cracks. The steel pistons are machined all over, inside and out, thus insuring uniform thickness and quality of the metal. The piston rings are of cast iron with keepers especially designed to prevent firing through over the piston rings. The wear of this metal on steel cylinder walls has had a number of years' trial in gas-engine practice.

The governor is of the centrifugal type, positively driven by the lay shaft, and operates the mixing-valve rod through a powerful oil-piston relay. The travel of this rod from no-load to full load is about 7 in., giving the governor a wide selective range and great accuracy in adjusting the amount of mixture to suit all possible loads. The engine will take a load on natural gas, dropping from 550 kw down to 50 kw in less than 10 seconds, without the slightest disturbance in speed. At extremely light loads the speed is still steady and constant, with no misfires or disturbances.

Now all of the above results were not obtained merely because the valve-rod moves 7 in. Mr. West, the designer of the new Bethlehem engines and former chief engineer of the Westinghouse Machine Company, is responsible for most of the exact and careful thinking that went into the valve-gear design. His idea was that for smooth, successful paralleling, especially on the high heat-unit gases, something more than the mere control of the throttle or the rise of the inlet poppets was needed. Not only must the governor control the quantity of mixture admitted, but also it must control the time of this admission. In former engines the governor controlled the quantity of mixture admitted by varying the opening of the gas and air ports. In the new engine the time that these ports are open is varied by the governor, simultaneously with the amount, so that one is a function of the other. If the ports are open three-quarters and the time they are open is three-quarters of the stroke of the inlet cam, the amount of mixture admitted will then be one-half. It is thus evident that even at very light loads the ports will still be opened appreciably, as the time that they are admitting mixture is very brief. The net effect of this action is to prevent wire-drawing in the case of light loads, which, in the movable-port method, would reduce the ports to mere slits, and at all other loads it will give the governor great accuracy of selection.

It may be well to analyze the action of the governor. The effects of wire-drawing in the one case would tend to vitiate strongly the proportions of air and gas in the mixture; in the other case a slight error of position of, say, 1/8 in. or so in the travel of the valve rod will make little difference in the mixture when both the time and the aperture control the amount of admission, whereas it would make a vast difference when only the aperature varies, the ports being, say, only 7/8 in. wide. When the governor itself is positive-driven and virtually dead-beat the operation of this mechanism of control is to follow the load almost as promptly and exactly as a Rites steam-engine governor. The steadying effect of an engine thus governed when put in parallel with engines of the older type is very noticeable. The feature, while not essential with weak gases, like blast-furnace and producer gases, is of tremendous advantage in running engines using high heat-unit gases, such as natural gas, crude-oil gases and oil-distillate gases.

Another feature of the Bethlehem engine which the earlier designs have not utilized to the fullest extent is that for every given mixture the one best point of ignition is obtainable by adjusting the end of the rod controlling the timing of all four igniters. In a steel plate there is cut a slot, the curve of which has been determined empirically, and the end of the timer rod can be fixed at any point in this slot by a bolt and wing nut.

This simple arrangement is well worth while for the sake of economy and smooth running. The igniters themselves are mechanically operated, yet they can be placed at any point around the circumference of the cylinder. They have been made in this manner because in the designer's judgment the timing is more exact with mechanical igniters than with magnetic.

The quality of the mixture for all four inlet valves is adjustable at one point by a large hand-wheel which varies the gas, the air being constant at atmospheric pressure. Butterflies have been provided in each inlet connection, however, for use when one of the cylinders might be crippled through a defective igniter, leaky poppet or such cause.

EMPLOYER'S LIABILITY FROM AN ELECTRICAL VIEWPOINT.

By Sidney W. Ashe.

THE recent meeting of the National Civic Federation and the general discussion at this meeting call to mind a number of observations which have been made by the writer from time to time while giving testimony in electrical accident cases. It has been customary for a number of years for the average individual to regard all corporations as soulless, this feeling being as strong with the employees of the public-service corporation as with the general public. This feeling has undoubtedly resulted in undue influence so far as the general jury decision is concerned.

For the past few years the condition has been slowly improving with the general public, and has practically disappeared in the minds of employees of these companies. A factor which no doubt has had some influence in bringing about this change has been the general recognition on the part of the central-station managers that one must recognize his debtor. He also realizes that he has three duties to perform—his duty to his directors, his duty to the public and his duty to his employees. A failure in any one of these three duties would rupture the organization. Concerning his relations with his employees, much is being done at the present time by the central-station manager to generate good-will. Benefit associations are organized, to which the company contributes annually in addition to the employees. In addition, in case of accident the wages, doctors' bills, etc., of the injured are borne by the company, and in case of death, benefits are frequently gotten up for depending ones. In case of extreme distress it commonly happens that contributions are given by the management from their own private funds. Positions are often created for the wife of a deceased, these positions requiring only a little labor, but bringing in sufficient revenue to prevent distress. Educational courses are given to the employees, teaching them the principles of their apparatus and the dangers associated with their use.

From a general résumé of many accident cases with which the writer has been associated, he feels confident in stating that 90 per cent of the accidents which occur are due to some inadvertance on the part of either the injured or his fellow workers. It is often urged that more accidents occur in this country than abroad. This may be true, but when it is remembered that in New York City alone there is more electrical power developed than in all of Germany or Great Britain, it is questionable whether the percentage of injured to employed is not less in this country than abroad.

The question of protection is one which is constantly before the minds of a central-station manager. How far shall protection continue? Books of rules and regulations are often printed and distributed to the men for regulating their action when in danger or when others are in possible danger. Printed rules are posted in conspicuous places, rubber gloves and insulated tools ar given to the men, and, above all, the fracture of a rule is a cause for dismissal.

The problem of enforcing the rules is often difficult. An instance may here be mentioned. It is a general practice followed by all the progressive companies that whenever a cable carrying high-tension energy is to be repaired the system operator should be called up on the telephone and notified. He will call up the various stations controlling the cable and have the switches controlling the cable opened, blocked and tagged. The tags state the time the switches were ordered opened and the name of the individual ordering the cable cut clear. When the cable has been disconnected at all points no back-feed of power is possible. When directions have been followed, the foreman in charge of the work on the cable is notified and work is commenced. When the work is completed the reverse process is gone through. No one but the foreman can order the tags off the switches when the work is completed. In the case of a hurry job where the foreman was in the manhole, on completion of the work he had his assistant call up on the telephone and order the cable restored to service while he collected his tools. In this case it was necessary for the system operator to appreciate that it was not the foreman, but his assistant, who was talking over the telephone, in which event the foreman was called to the telephone and rebuked. In another instance a man was killed for neglecting to follow this same rule. Two cables were being tied together, one of which was a new cable. Precautions were taken to have the old cable opened and tagged, but the new cable was neglected on the assumption that it was dead. This cable, however, had been connected at the other end on the night before to the main bus. The new cable was cut into and the individual so doing was killed.

There are, however, some cases which do happen where an individual is injured, due to negligence on the part of the management to provide a safe place for the man to work in. The writer remembers one case where an employee in a car barn began repairs under a car without displaying any sign or signal to indicate his presence under the car. Another employee mounted the platform of the car and started it, thereby killing the man under the car. A verdict was awarded the plaintiff. Such accidents are avoided by providing "Out of Service" signs and displaying signal flags and lamps to indicate the presence of the man under the car.

Steam railroad rules require a blue signal displayed in such cases—blue being used for this purpose alone, in order to make the rule distinctive. Electric railway men use a red signal for the same purpose. The flags are sometimes marked with metal tags giving the name of the employe making repairs.

A rule which has become quite common is that of not allowing any work to be done on any high-tension apparatus such as a switchboard while it is alive, because with all of the protection possible it was found that men were continually getting hurt. The rule regarding the use of rubber gloves is one which it is hard to enforce. Men find them disadvantageous when handling apparatus and become careless when their foreman is not looking and remove the gloves. The writer is acquainted with one case where the employee was provided with a pair of rubber gloves, had signed for them and read the rules regarding their use. Every day for a year or more he had ridden back and forth to work in a repair wagon in which duplicate rules were posted. Still one day when the foreman was not looking, on attempting to pull a cable which came into contact with another cable having defective insulation carrying high-tension energy, he was killed.

The solution of the question of liability seems to be in the use of proper protective devices, a rigid enforcement of rules and the establishment of some system of education whereby the danger points will be emphasized. If employees would carry a certain amount of accident insurance and consider the annual payments as part of the fixed charge which would go with accepting a certain class of work, the conditions would also be improved.

Many employees have been injured on electrical circuits through a lack of appreciation of the dangers of various voltages. It is difficult to formulate any hard-and-fast rule as to what voltages will kill and what voltages will not kill. The heart action is no doubt affected in proportion to the current which passes through the person's body and to the length of time that he is in contact. The magnitude of the current which passes through the body is dependent upon the resistance of

contact, to the resistance of the man's body and to the conductivity of the surrounding atmosphere. The writer has found by measurement that the resistance of individuals varies from 1000 ohms to 10,000 ohms, the resistance value appearing to bear no relation to the height or the cross-section of the individual, but depending largely upon the resistance of the skin. When the skin has been burned through, the bodily resistance may readily reduce to 500 ohms. Cases are known where an individual who has received 2000 volts has survived, and other cases are on record where an e.m.f. as low as 120 volts has proved fatal. The conditions surrounding the latter cases, however, have been peculiarly conducive to this effect.

In the Russian mines several miners have been killed on 120 volts in cases where they were surrounded with gases which increased the conductivity of their bodies. Another case was where an individual devised an electric shower bath. The water as it fell was charged with one potential, and the individual entered the bath with his feet in slippers containing conducting plates connected to the other terminal of the source. He was instantly killed. Cases have been known where individuals in cellars have been killed on low potentials. A horse seems particularly susceptible to low potentials. Horses have been killed in crossing railroad tracks where their fore feet have come into contact with one of the return rails and their hind feet have come into contact with the other return rail. The difference in potential of the two rails due to defective bonding was probably not great, but still sufficient to kill the horse. A case is on record where a horse standing in a pool of water has leaned up against a ground pipe coming down a pole. The ground connection was poor and the circuit inside of the building had one of its outer legs grounded, the result being that the horse was killed.

THE PREVENTION AND REMOVAL OF BOILER SCALE.—VIII.

By W. H. Wakeman.

A DEVICE used for treating water under full boiler pressure, illustrated by Fig. 1, combines the good qualities of the high temperature due to full pressure of steam with the advantages secured by using an external device that can be cleaned at any time, and that is not injured by furnace heat on the outside, nor the deteriorating effect of hot gases resulting from the combustion of coal in connection with soot and ashes. The device operates as follows: A settling tank 2 is made of any size suitable for a given plant, and designed to be safe under boiler pressure. A circulating pipe 3 delivers hot water from a point just below the water line of the boiler into the tank. Water from the pump or injector is delivered through pipe 4 in connection with the circulating water to the tank through the long sweep ell 5 which discharges against the convex head of the tank and thus tends to give motion to the water after it enters the tank. A suitable boiler compound is put into the tank and the treated feed water is taken out through pipe 6 to the boiler. The lower part of the pipe is perforated, as shown, in order to avoid taking a full supply from any one spot, thus securing smooth action of the apparatus. Oil and other light impurities which rise to the highest point may be blown out through the valve 7. A scraper rests on the bottom of the tank, and by drawing the handle 8 back and forth, the mud and other heavy impurities which have settled are stirred up, after which the blow-off valve 9 may be opened and the accumulated impurities discharged into the sewer.

Fig. 2 illustrates an ingenious device suitable for changing the quality of water for steam boilers and for various industrial and manufacturing operations. The water to be softened is delivered into the small tank 2 automatically, the supply being controlled by a float valve. A portion of this water goes through the curved pipe toward the left and passing thence into the tube 3 is delivered near the agitators in the lower part of this auxiliary tank or lime tower. The agitators consist of horizontal arms fastened to a vertical shaft, and the power required for turning them is derived as follows: A large portion of water delivered into the tank 2 passes into the tank 4, and in doing so turns the small wheel 5 on a horizontal shaft, the end of which is fitted with bevel gears meshing into corresponding gears on the agitator shaft.

The water which goes into pipe 3 is automatically treated with lime in the agitator tank, and coming in contact with water

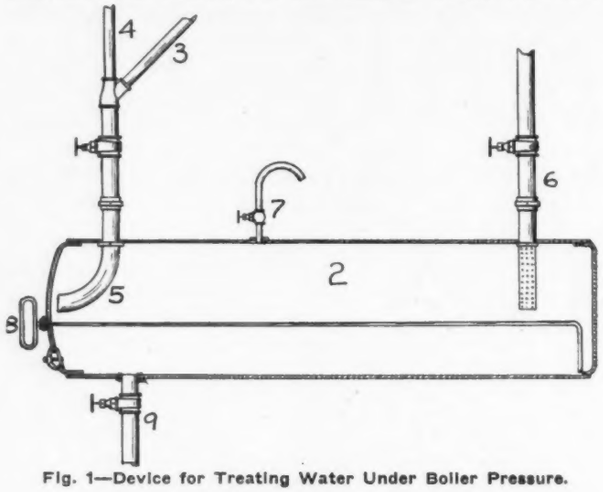


Fig. 1—Device for Treating Water Under Boiler Pressure.

containing dissolved bicarbonates of calcium and magnesium, robs them of a portion of their carbonic acid and reduces them to simple carbonates, which appear in the form of very fine insoluble powder, rendering the water turbid. The whole is delivered into the purifier and finds its way into the lower part of the tank. Around the central tube 6 are convolutions of sheet metal placed at an angle and a short distance apart, so that water issuing from the bottom must in its upward course to the overflow travel around the convolutions. By the time the water reaches the top all of the matter in suspension is

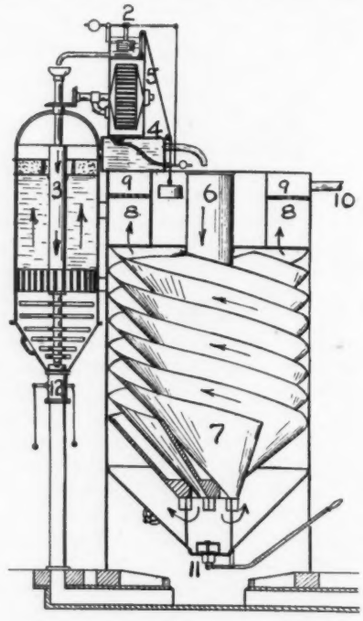


Fig. 2—Continuous Water Softener.

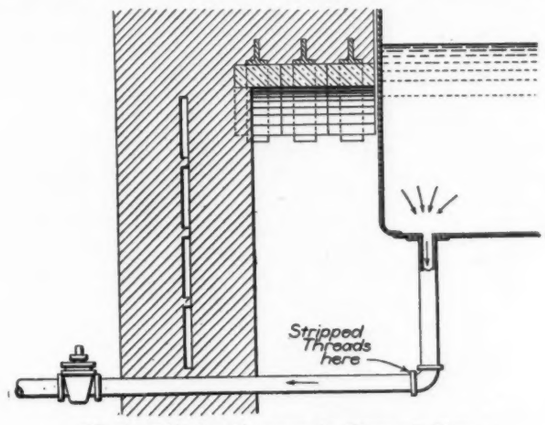
deposited. The water passes upward through the filter 9 and is drawn off through pipe 10 for general use.

The whole operation is entirely automatic after the proper quantity of lime is put into the agitator tank, and this requires but a few minutes each day. When sludge collects at the bottom of the main tank it is blown to the sewer through the quick-opening valve 11 and the agitator tank is cleaned through valve 12 in the same way.

LETTERS ON PRACTICAL SUBJECTS

EFFECT OF SEDIMENT AND WATER-HAMMER ON BLOW-OFF PIPES.

The importance of keeping blow-off pipes free from deposits of scale and from sediment is not always appreciated, and it is only when the sediment causes the pipe to burn and an accident results from this cause that the subject receives any attention whatever. There is only one way to keep the pipe free, and that is to open the blow-cock enough to keep everything flushed out of it. A safe rule is to open the cock once a day and if the water is of such condition to warrant it, two or three times a day if the boiler is under full load all the time. The time to do this is in the morning before the fires have been started up because most of the sediment in the boiler will then have settled to the bottom of the shell. Noon is also a good time, or at any time when the demand is low or the fires are banked. It is not enough to open the blow-cock a little way; it should be opened wide, and it should not be opened with a yank or closed in a like manner. No valve in a steam piping system should be thus opened or closed except in emergency, because sudden strains which such action causes are more destructive that the same strains applied gradually. The blow-off cock especially should not be closed suddenly. The reason for slowly closing the valve will be evident to anyone familiar with the hydraulic ram. In this apparatus the extra pressure caused by the sudden stoppage of a current of water is put to practical use and caused to raise



Effect of Water-Hammer in Blow-off Pipe.

a part of the water a considerable height. The water is permitted to flow through a waste pipe until it acquires considerable velocity; the waste pipe is then suddenly closed by an automatic check valve; the pressure, owing to the momentum which the water has acquired, increases rapidly, and portion of the water is forced out of a check valve into a delivery pipe connected with some overhead reservoir, tank or pond. If properly designed, a hydraulic ram will delier water into a tank when the delivery head of the ram is 20 times as great as the supply head. The effect of a too sudden closing of a blow-off valve is illustrated herewith. A boiler 5 ft. in diameter was fitted with a blow-off pipe arranged as shown, and when the cock was closed, the pipe gave way by stripping the threads at the point indicated and the fireman was scalded so severely that he died not many hours afterward. The actual stress thrown upon the blow-off pipe by the sudden closing of the cock was estimated conservatively at 2304 foot-pounds. This energy had to appear somewhere, and inasmuch as water is quite incompressible, the piping gave. The quicker the valve is closed the greater the strain, and unless the blow-off piping is very much heavier than usual, the inevitable result is a break, followed by scalding in many instances. The only safe way to close a blow-off cock is to turn it slowly so that the time required is several seconds at least. If this precaution is taken and the cock opened daily or twice a day under the conditions mentioned, troubles with blow-offs will become a minimum and distressing accidents, which do much to unnerve the entire operating force, will become greatly reduced, if not entirely avoided.

BUFFALO, N. Y. HERMAN STEGER.

THE USE OF OVAL CONDUIT.

The writer was somewhat surprised to find that only the regular round-pipe conduit is used in this country for interior wiring, even by those contractors who might be expected to be always on the lookout for improvements in methods, fittings and accessories which would either tend to cheapen the cost of an installation or increase its efficiency. In England there is on the market an oval conduit, introduced with the laudable intention of reducing the cost of labor on concealed-wiring jobs, but which has never become very popular for some reason or other. Inquiry among numerous contractors in this country has revealed the fact that without exception no contractor with whom I have spoken had even heard of such a thing. The conduit has many points of advantage over the round pipe. The idea of having an oval or flattened section is that when run on the surface of brick walls or ceilings, it will be covered entirely when the plaster is laid on, without the necessity for making a chase in the brickwork. Its capacity for wires is as great as that of round conduit, and to accommodate more wires it is only necessary to employ a wider tube having but the same projection. The conduit can be run in conjunction with ordinary pipe by the use of adapters, so that it is not open to objection on this ground, while its small projection permits its use, at least in England, on the under side of ceiling joists, where it may be run between the lath and covered by the plaster. The saving in time and labor as compared with the ordinary method of pulling up boards and cutting the joists is considerable. Its greatest value, however, is its use for switch runs down side walls. With oval tube no chase is needed and its slight extra cost is more than offset by the saving in labor. I understand that such conduit is not procurable in this country, so that it cannot be used; but once the advantages are appreciated there is no doubt but that conduit manufacturers will list it with their other goods and that it will find wide application. I find that in other matters, excepting perhaps cheap wiring installations, of which there seem to be none in this country, wiring installations are far superior here than abroad. I doubt not but what the cost is unduly high also.

CHICAGO, ILL. J. HENRY YOUNG.

TROLLEY FOR ELEVATOR BELL.

Having had much trouble with the flexible cables attached to a number of freight and passenger elevators in a large factory, through open circuits and the tedious time spent in locating breaks, a scheme of pipe conductor was tried in place of cables. A line of new ¾-in. iron pipe was built from the cellar to the top floor along one side of the elevator shaft where the clearance between the car and the wall was about 2 in., and out of the way of all doors. This pipe was securely braced about every 8 ft. to prevent it from being bent easily by any accidental blow from a hand truck or case being loaded on the car. The pipe was also built perfectly plumb, so as to be equally distant from the car at all points of the elevator shaft. At braces tees were used, and all couplings were beveled so that a trolley wheel could ride up and down without jumping the track.

A trolley wheel of either cast iron or brass was placed just under the edge of the car floor timber so as to ride the pipe conductor, the wheel being deeply grooved. The frame holding the trolley wheel was made adjustable to suit the tension by a coil spring, and a stop nut prevented the arm holding the wheel from reaching out too far and catching on the floors in case the wheel should be accidentally removed. With much travel the wheel soon wore a shiny path on the pipe, and a little oil on the wheel shaft did not increase the resistance appreciably. With these elevators no annunciators were used, only loud gongs, and the car is signaled by repeated rings.

One lead from the battery is connected to the pipe line, the other lead to one side of each push-button. From the other side of the buttons a connection was made to the machinery so that the circuit would follow the lifting cables. The gong was

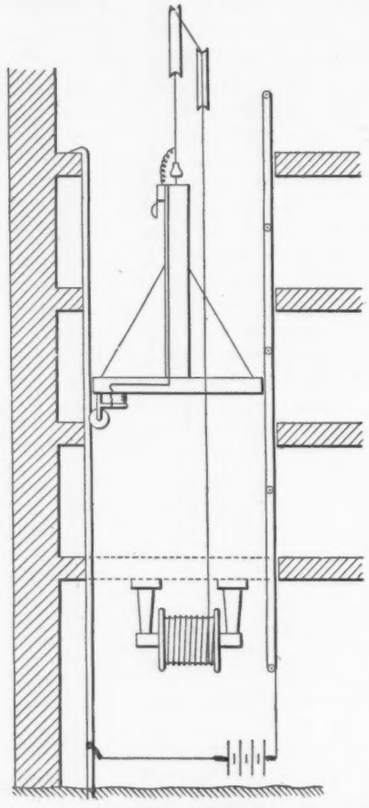


Fig. 1—Arrangement of Elevator Circuit.

placed with one binding post connected to the cables and the other post to the trolley wheel. Good connections were secured at all points. It might be mentioned that a sliding bow spring was tried, but it soon wore in two pieces.

Around a large factory many things should be made fool-proof, or else they are likely to be played with by some employee in an idle moment, with the result that something is wrong along the line. An ordinary type of push-button generally can be taken apart and short-circuited, and for the above elevators

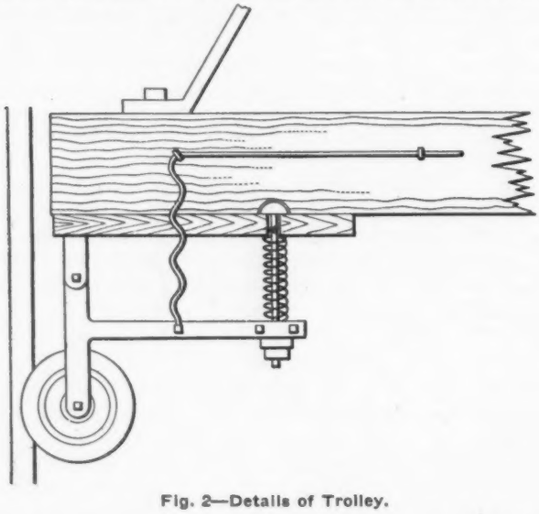


Fig. 2—Details of Trolley.

the push-buttons are made of 3-in. cubes of hardwood, with a carriage bolt for the button. The bolt is locked by running a nut down to the depth of the boring in the block, then a coiled brass spring is slipped over it and a brass plate used to guide it. To this first plate is attached one wire of the circuit. The other wire is connected to another strong brass plate set flush with the back of the block. The block is bolted or screwed to an iron or wooden post and is ready for all rough treatment.

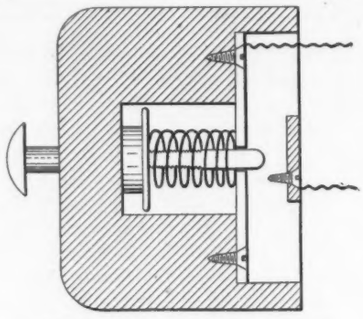


Fig. 3—Detail of Push Button.

It may be struck with a hammer and survive, because the push-bolt merely strikes the back plate, which cannot be dislocated. The whole push-button is fool-proof in every way, and is easily repaired.

Poughkeepsie, N. Y. H. S. Rich.

OPERATING A LIGHTING PLANT IN CONNECTION WITH ANOTHER INDUSTRY.

Mr. Jones was a small contractor located in a town of 2000 inhabitants. There was no planing mill within 25 miles. He was located 18 miles from the railroad. Freight rates on lumber by rail were $7.50 per 1000, and 18 miles by wagon, $2 per 1000. He concluded that he could save money by putting in a planing mill, so he proceeded to San Francisco and purchased a second-hand engine, boiler, shaper, sticker, band saw, edger, matcher, shafting, belting, etc., without consulting anyone but the second-hand man who had the goods for sale. The dealer did not have the proper size pulleys for the machines, but, of course, sold what he had. With the assistance of a cross-country machinist, whose father once hauled water for a threshing engine, he proceeded to install the plant in first-class working order. After some three months' of experimenting they succeeded in getting it into operation and managed to turn out work in some manner, getting it a little cheaper than they got the finished material shipped in, not taking into consideration anything for their time. If he had allowed himself a first-class mechanic's wages, the material would cost more. The mill did not furnish enough shavings for fuel, hence the contractor was compelled to buy wood at $6 per cord.

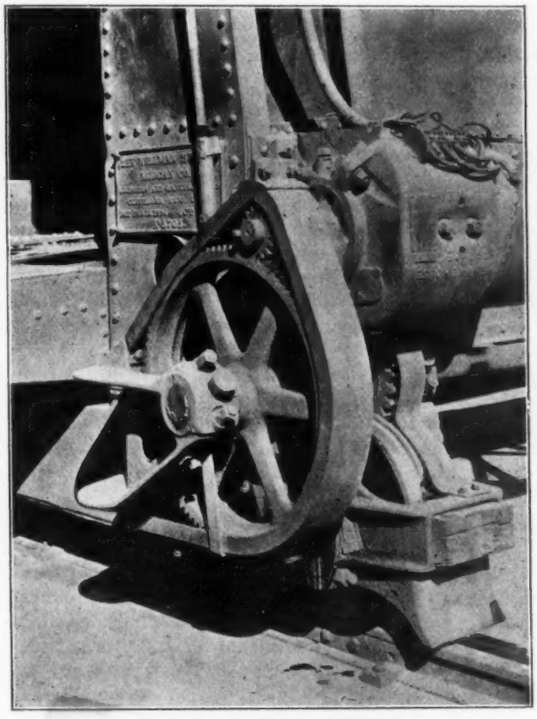
The writer went to the town to install a new saw mill near there and a planing mill in the town. After completing the job a call was made on Mr. Jones, and his plant inspected. There was a country engineer running the plant who knew how to start the engine and pump water in the boiler. The engine had been in a saw mill before. It was too small, and the valve had been cut away on the edges, increasing the cut-off to seven-eighths of the stroke, hence, doubling the steam consumption, to say nothing of that wasted through the leaky valve and piston. An estimate was made for putting the plant in running order; the cost of which did not amount to one year's loss under the present operating conditions, but the owner concluded that he could not afford it. In six months the mill shut down as the new mill could turn the work out for less money than it cost them and much better work at that, so the outside jobbing all went to the new mill. The writer afterward visited the place again to see how things were progressing and to look the town over with a view to erecting a lighting plant. After a thorough investigation a deal was closed for modernizing Mr. Jones' mill and to put in a lighting plant for him. A 60-kw, 1100-volt generator, 1½ miles of line and two 40-hp oil engines were installed and have been in operation one year now. There are 800 lamps in operation at a flat rate of 75 cents per month, or $600 per month gross income. One engine is sufficient to run the planing mill and by speeding up the machinery and putting in

a new sticker, new belts, etc., the planing mill pays all expenses of both mill and lighting plant, so that the income from lighting is clear profit. There are many good opportunities on the Pacific Coast for lighting plants yet. The large power companies do not generally bother the small plant as they prefer to market the energy at wholesale and let the small plant do the distributing, the latter plant being shut down and held in reserve. There are, however, quite a few defects in such systems, however, which could be remedied with profit.

VALLEJO, CAL. M. C. LORD.

SAFEGUARDING LIFE AROUND ELECTRICAL MACHINERY.

There are very many accidents which occur around electrical machinery which could be avoided if the machinery were properly protected. Many of such accidents are common to all kinds of moving mechanism, so that what is said relative to electrical machinery might apply to other machinery as well. In the mills with which the writer is connected, the gear wheels and rapidly moving parts of machinery are protected by guards or have a railing placed around them so that it is impossible for one to come in contact with them except on purpose. The engine



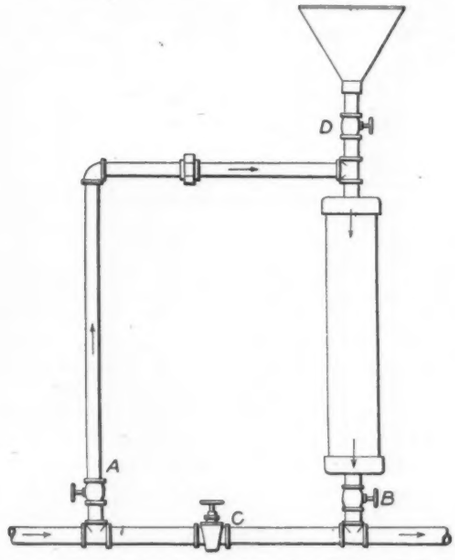
Protected Gears on Motor.

which drives a 650-kw generator, for instance, has the crank disk and main rods shielded with a covering of polished iron. This not only serves to prevent any possibility of accident to the engineer or others coming in contact with moving parts of the engine, but also answers the further purpose of preventing oil and grease from being thrown around the engine-room. Steps and hand railing lead from the floor to the journal bearing, and necessary guard rails and toe boards are provided around the flywheel and flywheel pit. These protect workmen from falling into or being injured by the flywheel. The accompanying illustration shows a section of one of the charging cranes employed in the open-hearth department of one mill. A number of accidents have occurred in such departments. Persons standing on the track have been run over by the crane, the operator being busy in watching his work. In order to avoid accidents of this kind, a guard was placed in front of the track wheels and shields were affixed over the gears of the motor driving the crane. Not only are all the motor gears thus encased and guard rails placed around machines with which persons in passing are liable to come in contact, but the rear of the switchboard is thoroughly insulated so that one could touch any and every wire on it and not receive a shock or burn. There is a railing in front of that portion of the board having copper knife switches so that only the switchboard operator comes in contact with these. It is planned to remove even the knife switches and to employ distant control so that only persons skilled in the art will deal with certain classes of apparatus. While such precautions are made in the interests of humanity and cost considerable, they, nevertheless, add to the peace of mind of the operators and result in much better work and feeling. With the class of help usually employed in steel mills, it is necessary to adopt such safeguards, and even where the labor is of a much higher order it is well to use the same precautions against accident. There are many important substations connected to transmission lines, for instance, which have a sole attendant, and should accident befall him, a whole city may be put to no end of inconvenience, if his duties are operative and not supervisory.

PITTSBURGH, PA. C. W. HAINES.

ARRANGEMENT FOR INTRODUCING SOLVENTS INTO BOILERS.

There are many convenient methods for pumping soda-ash solution into a boiler and the solvent can also be introduced by means of an injector. These methods are employed to a considerable extent, but are open to the objection that the soda ash in passing through the pump rots and eats the packing, especially when the latter is soaked with oil or grease. Where such is the case the arrangement shown herewith has been recommended and it possesses the advantage of not requiring



Arrangement for Introducing Solvent in Boiler.

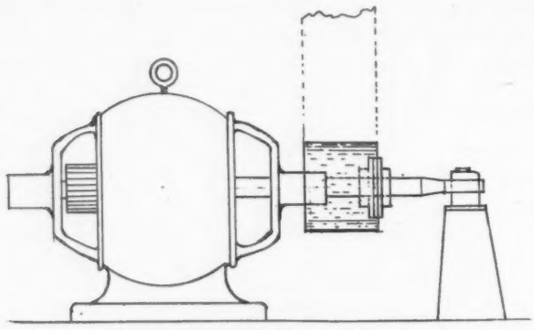
a pump, although the piping is a trifle more complicated than where a pump is used. The reservoir for the solvent consists of a piece of 6-in. pipe about 3 ft. long. It connects with the feed-water pipe running from the pump to the boiler and the pipes are so arranged that they join with the feed pipe on opposite sides of the stop valve *C*. The reservoir is fitted with a funnel by means of which it can be filled through the valve *D*. Pet cocks should be provided at the top and bottom of the reservoir so that the air can be permitted to escape when it is being filled, and also in order that it may be easily emptied. To facilitate the assembling of the piping a union should be placed in the upper line where indicated. The apparatus is used as follows: The valves *A* and *B* and the pet cock on the bottom of the reservoir are closed, while valve *D* and the pet cock on the upper end of the reservoir are opened. The soda-ash solution is then poured into the funnel until the reservoir is filled. This will be indicated by the solution coming out of the upper pet cock. The valve *D* and the upper pet cock should then be closed, as well as the valve *C* in the main pipe. The valves *A* and *B* are next opened and the feed pump started. The water

from the feed pump then passes around through the branch piping and sweeps the contents of the reservoir into the boiler. When all the solution has been removed from the reservoir, valve *C* may be opened and valves *A* and *B* closed. The device may then be refilled and placed in operation when required.

Philadelphia, Pa. George Warner.

THE INSTALLATION OF LARGE ELECTRIC MOTORS.

There is much room for improvement in the installation of large electric motors intended for certain classes of work, and the scheme shown herewith may serve a useful purpose in indicating what can be done in this direction. The method is employed by a concern in changing all its motor installations. The machines, like others, had only the ordinary bearings found in ordinary practice. It was necessary for them to be connected to double leather belts operating on comparative short centers and instead of placing all this strain on the pulley bearings, a flange coupling was used to connect a short piece of shafting to the end of the armature shaft, which was extended about 2 ft., and was reduced in diameter as indicated, so that the bearing would not be too large. The scheme



Motor Fitted with Extra Bearing.

has worked well in connection with a number of large motors and reduced the excessive wear which would have come on the pulley end of the shaft to a minimum. The extra cost of the device is small for those companies who are in a position to effect their own repairs and within the range of other companies as well. The small pillow foundation can be easily and cheaply built of concrete, and the design may be changed to suit the different requirements. Of course, where a three-bearing motor can be obtained, the wear on the pulley ends is divided between those bearings, and such an arrangement is preferable to the home-made affair shown. There are many two-bearing installations, however, where the wear on the pulley end is quite excessive and where the installation of another bearing would help matters considerably.

Richmond, Va. C. R. McGahey.

NEAR-SIGHTED ELECTRICAL ENGINEERING.

This letter is dedicated to engineers and others troubled with myopia, and is based on an experience covering a period of 20 years and observations from a practical standpoint. In calculating the size of feeders to be run from a power plant to a distributing point the tendency has been to install just sufficient copper to take care of the present requirements with small overload. Experience has shown that at least 50 per cent more should be figured upon than is actually required, both in feeder capacity and generating units; especially on motor circuits, where 50 per cent more copper could be added to each circuit and then an additional 50 per cent added to the total. It will be found in the near future that this is hardly large enough to take care of the present-day advance in the electric application of tools and machinery. On a lighting circuit, also, each branch should have the same percentage as stated above and the same added to the total. It has been demonstrated in nine installations out of 10 that power plants and feeders installed to-day will, in less than a year, be entirely too small and insufficient for the work required of them, so profiting by the mistakes of others in outlining plans for future installations, one is able to come nearer to the actual requirements by being more liberal in the beginning and less near-sighted.

Bearing these facts in mind, if the prospective user of electricity in giving his order to an engineer to make up plans and specifications for a power plant should go over the plans with him, and happen to find that the engineer doubled the size of each feeder and generator and specified an absurdly large feeder to a very small motor, or put in only six incandescent lamps where he could safely and easily have put in 12, he should not find fault. If the engineer knows his business he will apparently outrageously waste money in expensive apparatus and unnecessary wiring and other foolish plans for the future, which before the year is past, will probably be found too small and cause the owner to wonder why the engineer did not specify a much larger feeder and generator in the first place, although his plans for the future at the time they were drawn were tabooed.

In laying out the switchboard for the power station if the engineer should happen to reserve some room for a few future panels and should insist on placing the present panels in the center of the engine-room and 8 ft. or 10 ft. from the wall when they could just as well have been put in some corner, he should not be discouraged. Being progressive he will put the switchboard in a central location with the object in view that he may want to add a few more panels sometime or other. With the arrangement specified this can be done without unnecessary cost, because the engineer can work both ways from the center with new panels, and the 10-ft. space that might have been objected to will probably save several claims for damages and at the same time give plenty of room for men to do any work behind the switchboard. The space will also come in handy for additions to the board in a pinch without going to the expense of building a new structure in order to extend the switchboard or increase the generating capacity. Too often the owners of plants hold their hands up in the air and squeal "robber" and "fool" when the engineer orders heavy lead cables for feeder lines and insists on putting them underground, buying a good vitrified conduit to put them in and adding a few more holes extra, for future use, not to mention a concrete foundation for the conduit, bandages on the joints, cement envelopes, etc., because the owner feels he could have saved money by simply laying the cable any old way in the ground and covering it up with a plank. The same owner is usually very much surprised when, after he had doubled his private business and found that he had to erect a new building and equip it with electricity. wondering what this was going to cost him, the power-plant engineer came along and just hauled a few more cables into the same expensive conduit to his new building without extra cost but for the wire and cable and the labor it took to pull it through the holes he swore would drain the money out of his pockets when they were first put there. Most likely he would say: "Why in thunder didn't the fool put in a few more holes when it did not cost much more to do so?" forgetting entirely the time he called him a robber and told him that his expensive habits were driving him to the poorhouse. When the new building was being wired the same level-headed business man will kick hard when the engineer ordered a good grade of rubber-covered wire and committed the folly of buying steel conduit to put that good wire into and piped up the job as if he were going to run steam or gas through them. But if it should happen that a small fire broke out in the building caused by some carelessness, and in extinguishing the blaze the firemen flooded the place with water, while the owner was tearing his hair, cleaning up the mess, and getting in shape to run his shop or machinery, his engineer should come around and told him that this foolishness on the conduit job had saved the day and a few dollars besides, as the electricity could be turned on as soon as the place was cleared, because the wires were not damaged any, except for a fuse or two, which was replaced, the owner would be amazed.

Council Bluffs, Ia. Frank J. Smith.

QUESTIONS AND ANSWERS

What are the limiting voltages where pin insulators give place to those of the suspension type? H. P.

With rare exception nearly all the transmission lines in this country working at less than 65,000 volts use pin insulators, while above this potential, insulators of the suspension type are employed.

Where on a switchboard should heavy circuit-breakers be fastened? A. S.

Circuit-breakers fed from heavy buses on which excessive short-circuits may occur should be placed in such a position that the arc and hot vapor due to their opening cannot harm any other apparatus on the board. The best place for such apparatus, therefore, is at the top of the board with the carbon contacts projecting above the upper edge.

How are dry cells rated, and how may they be tested? J. G.

There is no standard method of rating dry cells at present. The usual method is to rate the cells by dimensions or by the short-circuit current obtainable from them. Life tests are made by connecting the cells permanently in circuit with a fixed resistance. The subject of dry-cell rating is at the present time under discussion by the American Electrochemical Society, which has appointed a committee to standardize methods for rating and testing batteries of this type.

For what purpose is the oil kept on the solution in the Edison primary battery? I have been informed that it is to prevent creeping of the salts; but it would appear that cheaper means were available, if such is the case. A. M. P.

The impression which seems to prevail in many quarters that the oil poured on the solution in the Edison primary cell is intended to prevent creeping of the salts is erroneous. The oil is intended to keep the caustic potash solution from contact with the air, otherwise the caustic potash would absorb oxygen from the atmosphere and become reduced to a carbonate and the life of the cell shortened.

I note in reading a description of extra high-voltage transformers that the insulation of the high-tension leads where they pass through the case of the transformer is of the condenser type, and I would like to know what this means? C. B. J.

The object of the so-called condenser-type insulation is to obtain a terminal over the surface of the insulation of which the potential gradient shall be nearly as possible uniform. This is done by embedding in the insulating material metal laminæ whose dimensions are so chosen that the capacity between any two laminæ is the same, this giving a number of equal increments of potential from the case of the transformer to the live conductor.

What is the basic principle of interpole motor design? C. D. O.

The principle of all interpole designs is to provide a small auxiliary pole between two main poles in such a position and so proportioned that it will provide just such a field as is suitable for counteracting the reactance voltage of the short-circuited coil under the brush. The interpole is always series wound and its winding carries the whole, or a fixed part, of the armature current. Thus, so long as the iron is not saturated, the field strength under the interpole is always proportional to the armature current; so that if the design has been correctly worked out to give good commutation, say, at full load, the same relation will hold between field strength and the armature current to be reversed at any other load, and the machine will work sparklessly without any change of brush position at any load, the only limit being the saturation of the iron core of the interpole. That is, the machine will carry sparklessly and without change of brush position any overload up to the point where the increased ampere-turns on the interpole cause the iron to approach saturation.

In changing over from 125 cycles, 110 volts to 60 cycles, what effect will the change have on the accuracy of the Scheeffer meter? Is it possible to use the Thomson ammeter and voltmeter on 60-cycle circuits without having any errors in the readings, compared with the readings of the same meters on 125-cycle circuits? A. J. A.

The Thomson ammeters and voltmeters can be used with 60-cycle current with the same degree of accuracy as when employed with 125-cycle current. The Scheeffer watt-hour meter, which is adjusted to read accurately at 125 cycles, will be slightly inaccurate at 60 cycles, but can probably be readjusted so as to give accurate results at the latter frequency. When used at the same voltage with the lower frequency the heating in the shunt circuit will be slightly greater.

Why is it that a milli-voltmeter can be employed to measure the current in a circuit? W. U. E.

When a milli-voltmeter is used to measure current, the current is sent through a low resistance and the milli-voltmeter is connected across the terminals of this resistance, or shunt, as it is called. The pressure across the shunt is proportional to the current flowing, and this pressure causes the deflection of the milli-voltmeter, the deflection being proportional to the main current. Viewed in a different light, a small portion of the main current flows through the voltmeter and the greater part through the shunt. Since the resistances of the voltmeter and shunt are fixed, it follows that the current in the voltmeter, and hence the deflection, will be proportional to the main current.

We operate a 500-volt circuit, from which we supply a railway load. For some reason or other the circuit-breakers are set not to exceed a certain maximum current, which is much too low for the service. As a result they are continually opening at times of heavy load, and unless the attendant is at the switchboard they may remain open some minutes without being detected. Is it not possible to arrange some sort of signaling device in connection with the circuit-breakers so that when they open notice of that fact will be given? K. B. B.

A very simple means of causing a circuit-breaker in opening to sound an alarm would be to attach a string to the handle so that when the overload came on and the handle dropped it would close a switch in a bell circuit. When the circuit-breaker is reset, the switch can be opened again. There are any number of ways of accomplishing the same results, depending on the ingenuity of the operator.

How can a compound-wound, four-pole dynamo be run as a shunt or series motor? The armature is provided with only one set of brushes. P. M.

To run the dynamo as a shunt motor, cut out the shunt-field rheostat, connect one shunt-field terminal to the corresponding armature terminal, and then connect them to one side of the supply circuit. Connect the other shunt-field terminal to the other side of the supply circuit. One terminal of the starting rheostat should be connected to the remaining armature terminal and the other rheostat terminal should be connected to the supply circuit at the place where the shunt-field lead was connected. Cut out the series field. The dynamo will not run satisfactorily as a series motor. It could be run as a compound-wound motor by connecting in the series field between the single armature terminal and the starting rheostat. The other connections should be as indicated above.

Kindly describe a convenient method for testing armatures for faults? Y. C.

Broken-circuits, short-circuits or partial short-circuits in armatures may be detected by sending sufficient current through the armature through the brushes, with an ammeter and resistance in series in one lead, to give a deflection on a milli-voltmeter when the latter is connected to two adjacent segments of the commutator. If no fault exists, a test all around the armature will give about the same deflection between any two segments. If a coil is short-circuited or only partially short-circuited there will be no deflection in the milli-voltmeter in the first instance, and only a small deflection in the second instance. If there is a broken coil the ammeter in the circuit will not indicate and the full voltage of the supply will be found between the segments to which the broken coil is connected. It is advisable for this reason to employ a high-reading voltmeter first, otherwise a milli-voltmeter will be burned out.

PRINTED MATTER ON METER BILLS.

There are very few electric light companies that do not print some sort of advertisement or notice on their regular monthly meter bills. In the majority of cases stock advertisements setting forth the merits of some electrical device with a picture of the apparatus are employed, and where these are continued, even though the advertisement be varied each month, they are apt to defeat their purpose; for a consumer who already has an idea that he is being overcharged, will be further embittered by the thought that the company is trying to induce him to buy something which will permit it to add still further to his bill. All arguments as to the convenience of the apparatus described are lost in the thought which predominates with him, that he is being robbed by the electric light company. With such a customer, the meter bill should be the last place for an advertisement of the kind mentioned.

Meter bills, however, can be made to serve a very useful purpose in winning the confidence of consumers and disabusing their minds of certain misapprehensions which always exist toward public-service companies. Not that the company should take customers unduly into its confidence, although much of this might be done with profit; but it can extend sensible advice to its patrons on matters concerning which it is supposed to have superior knowledge. For instance, the October bills of the Northern Connecticut Light & Power Company, of Windsor Locks, Conn., have printed upon them the following reminder:

"The time of the year is at hand when the days shorten and the nights lengthen. Naturally, more artificial light is needed, and from the lack of care much light is wasted. The light you waste does no good, and costs you money; therefore, we recommend the following: 'Turn off the electric lamps when not required; you don't even need a match to relight them. Use lamps of small candle-power for halls, pantries, cellars and attics. Use a drop lamp or portable electric lamp for reading; one lamp low down is better than three lamps high up in the air. Where an all-night lamp is required use a turn-down electric lamp which works like a gas lamp. If you have any trouble with your lighting service notify us and we'll make it right."

Such advice at a time when the days begin to shorten cannot but be appreciated by a customer, and while it may be the cause of cutting down the maximum possible revenue received by the electric light company, it is sane and will redound to its credit. The reading matter has in it a personal appeal and not only serves to forestall complaints, but to rob the serpent of its sting, so to speak. Moreover, it is of a kind to win public favor and general good feeling, two conditions to be coveted by any company.

The same company printed on its December bill matter pertinent to meters. The opening sentence, "Do you read your meter from day to day?" serves to quicken the conscience of any disgruntled user of electricity, who is then ready to imbibe the following: "It checks waste and saves the annoyance of unexpectedly receiving a high lighting bill. The current saved may be utilized to run a sewing-machine motor, a washing-machine motor or heat an electric flatiron. Dark, short, stormy days cost more for artificial light than bright, sunshiny days. You are apt to forget these things. A systematic reading of the meter will keep you posted as to just what these days cost; otherwise, a month later, when you come to pay your bill, you will have forgotten them. Read your meter, check waste and save money. If you do not know how to read the meter, we will show you."

The above are but samples of what can be done by an electric light company without being unduly solicitous regarding the expense of its patrons. Combined or printed alternately with advertisements of useful domestic appliances, the effect should be to engender good will and to induce the consumer to use any of the numerous devices which he feels he can afford. The last point should not be overlooked by a central-station manager. There are many useful electrical devices on the market which, while they might add to the income of the central-station company, it would be poor policy for the central-station company to push, unless its patrons are possessed of more than average wealth. Frankness in such matters is commendable; because the patrons of any company are first of all human, and incidentally users of electricity.

EDUCATIONAL CENTRAL STATION EXHIBIT.

As in former shows, the exhibit of the Commonwealth Edison Company of Chicago, at the Chicago Electrical Show of Jan. 15 to 29, will be of an educational nature, consisting largely of actual demonstrations of applied electricity, mainly as used for power. The company will have about the same space in the Coliseum, at the north end of the building, as last year, and will here make the power exhibit—that is, display electrically operated machines of various kinds in actual operation. Nearly all of the motors used will be three-phase, alternating current, of both constant speed and variable speed.

An especial feature will be an exhibit of artificial refrigeration. There will be a large refrigerator, such as used in meat markets, and also a large special refrigerated showcase of marble and plate glass, filled with meats. The contents of this showcase are not only attractively displayed, but are kept at the proper temperature automatically by means of an ammonia compressor controlled by thermostats and operated by a 3-hp motor.

Going from electric cold to electric heat, the next exhibit will be an electric furnace in which very high temperatures are employed in the tempering and annealing of steel. An attractive display will be the making of tin biscuit cutters used by cooks in stamping out biscuit dough for the oven. There will be the motor-driven punching, stamping and crimping machines used in making these devices and the soldering will be done by an electric solderer. Five men will be constantly employed in plain view of all spectators in making these biscuit cutters, which will be given away to ladies as souvenirs.

There will be a machine for spinning rivets in operation and also an automatic bolt cutter and threader. A large electric welding machine will be shown at work engaged in welding tin strips to iron strap—a process used in making bakers' pans and of a rather unusual nature. A power hack-saw will be particularly interesting as showing the application of speed-reducing gears, enabling a high-speed motor to operate a low-speed machine.

The office of the exhibit will be in the center of the large space and the entire western part of the exhibit will be devoted to a demonstration of the application of electricity in printing, binding and embossing. A monotype machine, used for type casting, will be shown in operation, and there will be a large Miehle press, driven by a variable speed, three-phase motor and a small Gordon jobber operated by a variable-speed, single-phase motor. An electrically heated and operated embossing press, a paper cutter, a folding machine, a stitcher and other machinery will be seen at work in this exhibit, all, of course, electrically driven. The work turned out here will be an attractive souvenir which will be printed, embossed and bound before the eyes of the spectators.

At the other end of the Coliseum, in the Annex, will be another exhibit of the Commonwealth Edison Company, consisting of a model electric garage, which will illustrate particularly the charging of vehicle storage batteries from alternating-current service, using both the single rectifier and the six-circuit public-garage rectifier. Adjoining this garage will be a lecture hall with comfortable seats where Mr. M. M. Wood will deliver a popular lecture accompanied by moving pictures on electricity and its general applications. Mr. Wood is most ingenious in entertaining audiences with his talks on electrical subjects, and this feature of the Commonwealth exhibit no doubt will be very popular.

Central Station

Management, Policies and Commercial Methods

COLLECTING CENTRAL-STATION BILLS AT FORT WAYNE, IND.

Auditor Harry Vordermark, of the Wabash Valley Traction Company, Fort Wayne, Ind., has just completed a system of continuous meter readings and billing for the electric light patrons of the company that went into effect Jan. 1. By the new scheme the city is divided into 20 districts, and each one is to have approximately the same number of customers. The meters of all these customers will be read on the same day, if possible, and bills rendered immediately. These bills will be payable within 10 days after date, as at present. This scheme will avert the month-end rush at the offices, resulting in an overworking of the clerical force and a waste of time on the part of the patrons, as under it the customers will be calling at the offices all during the month from various parts of the city.

RATIO OF WIRED TO UNWIRED HOUSES.

A recent canvass discloses a wide disparity throughout the country in the proportion of houses wired for electricity to those unwired. As might, however, have been expected, in cities and towns that have not grown largely during the past 20 years the proportion is small, the less pretentious older houses remaining unwired. The progressiveness of the central-station management is also doubtless an important factor, while in many places residence electric lighting has been hampered through the consolidation of electrical and gas interests. The largest ratio of wired to unwired houses is naturally in the relatively new cities of the West. For Seattle the percentage is 95, and about the same for Spokane, where only about 5 per cent of the buildings are piped for illuminating gas. Los Angeles and Denver have percentages of 90 and 70, respectively. Waterloo, Ia., has a third of its buildings wired, and Detroit, Mich., about a fifth. In the larger cities of the East the proportion is about 10 per cent, and that figure is not far out of the way for a great part of towns and smaller cities.

This survey indicates that electric lighting for residences is decidedly in its infancy, and that a vast field exists here for central station exploitation. With the high-efficiency metallic-filament lamp now at their disposal, central stations have means of meeting a condition not at all complimentary to electric lighting. With the new lamp, a proper system of rates, which system may involve a partial return to flat charges, and provision for wiring old houses on a basis of partial payments, there is an excellent prospect for removing the reproach.

TUNGSTEN CAMPAIGN AT DAYTON, OHIO.

The Dayton Lighting Company started last September on a vigorous campaign for the introduction of tungsten lamps and fixtures. In making this campaign one representative of the Tungstolier Company, one representative of the Holophane Company and three representatives of the General Electric Company were sent to Dayton to work the field. The start was made on Sept. 27, 1909. On Dec. 7, 1909, 3000 tungsten lamps had been put out and about $3,000 worth of fixtures had been sold. Of these about 35 per cent replaced artificial and natural gas installations.

To stimulate the interest of merchants and the public in tungsten lamps and to get the public acquainted with this lamp, the following ingenious guessing contest was carried on:

A prize of $10 was offered for the nearest guess on the actual number of tungsten lamps in use in stores fronting on Main Street between the railroads and the river. This contest was open for one week. The conditions of the contest were stated on a neatly printed folder. Many who heard of the contest came to the salesroom of the company to learn what the tungsten lamp was. The conditions of the contest required counting all the tungsten lamps on whatever public floor of a store they might be installed. The merchants on Main Street were naturally well pleased with this contest, because it brought them a number of visitors who went completely through their stores. Some merchants having tungsten lamps above the first floor posted notices to that effect.

The answers were received between 8 and 9 o'clock one evening. Previous to 8 o'clock the company's showroom was closed. People were admitted through turnstiles to hand in their guesses. There was a great crowd. After the contest was over the slips on which the guesses were handed in were piled in one of the show windows, with the correct number on top.

HOUSEHOLD APPLIANCES AT DAYTON, OHIO.

The Dayton Lighting Company has put out 1500 electric irons among 2250 residence consumers. Electric service in residence districts has been given for only about three years, hence the small number of residence customers.

FLATIRONS.

Last summer the company made a special flatiron campaign, partly to introduce flatirons, with the attendant increase in revenue, and partly to popularize electric service in the residence district. In this campaign, which lasted about three months, between 550 and 600 irons were sold. The method was to put all the company's six solicitors on this work for a portion of each week. A section of the city amounting to eight or nine blocks was worked each week. On Friday two boys in uniform delivered flatiron circulars stating that the company would place irons on free trial. On Monday or Tuesday the solicitor would call to get permission to deliver an iron on two weeks' trial. The irons were delivered in wagons on Tuesday. The irons sold were of General Electric and American types, the price being $4.50 each. It was announced that the free trial proposition would be withdrawn after Sept. 20, which was done, no more free trials being given until next spring. This was, of course, some extra inducement to make the trial without delay.

VACUUM CLEANERS.

About 25 Duntley vacuum cleaners have been placed in service. This cleaner is selling for $125. It is of small enough capacity to operate from any lamp circuit without changing the fuse on that circuit.

HEATING PADS.

More than 2000 heating pads have been sold, a special effort having been made on these. A solicitor was employed who was formerly a trained nurse. She first visited the doctors of the city and placed heating pads on trial with them. The doctors thus became familiar with the merits of the electric pad. The next step in the campaign was to get daily from the city health office a list of the births. Wherever the house which the stork had visited had electric service, a heating pad was left on three weeks' trial. The invariable result was the sale of the pad. Last winter about a dozen pads were sold to owners of gasoline automobiles for use in keeping the water-cooling tanks from freezing when the machine was standing in the private garage.

SEWING MACHINE MOTORS.

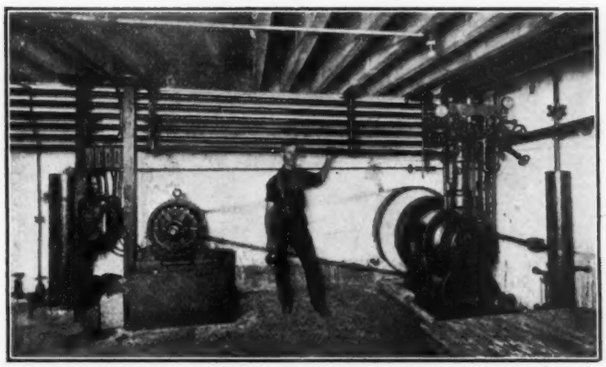
About 60 sewing machine motors have been placed in service. The motor which is now being pushed is the Bissell, which is easily applied because it is arranged to be attached directly to the shaft in place of the usual sewing machine flywheel.

The firm's refrigerator was on the first floor, occupying the width of the store, and was 16.5 ft. x 11 ft. x 9.5 ft. high, internal dimensions, and contained two ice bunkers, one on either side, which extended down to within 5 ft. of the floor. The bunkers so reduced the holding capacity of the box that only 40 tubs of bulk butter could be stored along with their other stock. The bunkers held from two to three tons of ice, and every time they were filled a commotion and slop for a half hour or more were created.

On April 25, 1909, the new refrigerating outfit was completed and in running order. It consisted of a 4-ton Brunswick compressor, 7.5-hp Westinghouse motor, 850 r.p.m. belt drive, six lengths of double pipe condenser, four brine tanks and 700 ft. of direct-expansion ammonia piping, nearly one-half of which was immersed in the brine storage tanks supported in the upper part of the refrigerator box. The insulation of the refrigerator was reinforced by a lining of 1 in. of cork board and one layer of ⅞-in. tongued-and-grooved board. This arrangement made the dimensions 2 in. smaller all around inside, but on account of the removal of the ice bunkers 200 tubs of butter can now be accommodated.

The cost of the machine outfit and the required changes was $1800. No repairs or expenses other than for electric energy, not even oil, have been necessary to date. There has been no labor charge, less work being necessary than with ice. The machine installed is considerably larger than the present needs demanded, the expectation being to erect another storage room, and possibly to make 1000 lb. of ice daily.

It was necessary to use ice on the wagons to keep the butter hard in summer. The butter is carried in hinged-lid boxes at each end of which are compartments for cracked ice. About 40



Arrangement of Refrigerating Apparatus in Basement.

lb. of ice to each 144 lb. of butter was used. The wagons carried in all 15 boxes. Three men were busy for one hour on each morning cracking this ice and packing it in the boxes. Some one conceived the happy idea of substituting cold brine for the ice, and cans were made 15 in. square by 3 in. thick, which fitted snugly into the end compartments. They are filled with brine, closed with a screw cap and placed in the upper part of the refrigerator to cool. In the morning they are lifted into the butter boxes in a fraction of the time formerly necessary to pre-

1. Date.	2. Weather.	3. Temperature Outside.	4. Temperature Box Start.	5. Temperature Box Stop.	6. Hours Run.
Thursday, July 1	Extra hot	93°	46°	36°	5
Friday, July 2	Extra hot	94	45	36	4
Saturday, July 3	Extra hot	85	46	35	8
Tuesday, July 6	Cool	78	51	39	5
Wednesday, July 7	Hot	80	48	37	5.5
Thursday, July 8	Hot	85	46	42	3
Friday, July 9	Hot	76	46	36	4
Saturday, July 10	Hot	81	46	36	3
Monday, July 12	Hot	83	50	40	4.25
Tuesday, July 13	Very hot	87	49	42	3
Friday, Oct. 1	Cool	66	38	30	3
Saturday, Oct. 2	Cool	63	38	31	3
Monday, Oct. 4	Cool	63	43	31	3
Tuesday, Oct. 5	Cool	63	41	32	3
Wednesday, Oct. 6	Warm	67	41	34	2.5
Thursday, Oct. 7	Warm	78	41	39	3.25

pare the ice. It has proved to be a very successful method, giving a vast improvement over ice. The butter is kept harder, the wet from melting ice is avoided, and time and labor are saved. When the wagons return after the day's absence the cans are returned to the refrigerator and the brine is cooled by morning, ready for another trip.

Mr. Hartman is a close student of the proper management of the outfit, and keeps a daily record of its working. Here are two samples, one for the hot period and one for October:

The "weather" column, it might be explained, denotes the personal feeling, and is largely dependent on humidity, hence the pleasant coolness on July 6 and the heat on July 9, when the mercury column showed differently. While the machine operated as shown in the last column, the temperature in the refrigerator was reduced from the figures in column 4 to those of column 5.

The proprietor is highly gratified with the record made so far, and states that the butter has been kept in much better condition than formerly, that it is improved in quality, and actually brings a higher price per pound.

The cost of electric energy to date, for six months, has been $243.71, and unless the weather should become unseasonably warm, no further operation will be necessary until next April. Three hundred and fifty dollars would certainly pay for a year's energy consumption. Ice during this last summer would have cost more than $900. With a 10 per cent fixed charge, there is shown a net profit of $400. The plant will, therefore, pay for itself in 4.5 years.

ELIMINATION OF GASOLINE COMPETITION.

The Disadvantages and Dangers from the Use of Gasoline for Interior Illumination.

By Jack T. Connors.

THE subject of illumination is one in which every merchant is especially interested and with some the desire to get the best for as little money as possible is the one ambition. This class is naturally easy prey for the gasoline salesman, and their wants and conditions should be carefully studied, for what may appear to be a slight cause for complaint may be the reason for losing a good customer.

The electric salesman who enters the fight with gasoline must, first of all, learn all the good as well as all the bad features of gasoline lighting systems. He must thoroughly understand the working principles and the many mechanical weaknesses in the different makes of plants now on the market. He must be able to give praise when praise is due and state facts when pointing out the many reasons why gasoline as an illuminant is not satisfactory. He should carefully guard against "knocking," for that alone may do untold harm.

The principal reasons why gasoline systems are installed are: First, dissatisfied electric consumers; second, low cost of operation; and third, misrepresentation; all of which when properly handled can easily be refuted. The gasoline solicitor is successful with the first because he selects for his prospective customers people who have some real or fancied grievance with the central-station management, and if left to himself, will soon have such people believing that their only salvation lies in the course prescribed by him. Frequent calls on the part of the electric solicitor will have a killing effect as far as the gasoline proposition is concerned, for when a consumer believes that a personal interest is being taken in his welfare, he feels that when things go wrong he can get redress through the one paying a little attention. This alone eliminates the gasoline competitor's best asset.

The second reason, that of low cost of operation, is not a serious one when the solicitor thoroughly understands the numerous difficulties of operation—high first cost, depreciation, maintenance and actual cost of operation.

The confidence of present and prospective consumers being once gained, the words and the facts presented by the solicitor have weight. The prospective gasoline user knows little or nothing of the plant in question and must depend upon others for his knowledge. If he feels that he can depend upon what

CENTRAL-STATION ENCOURAGEMENT OF ELECTRIC VEHICLES.

With the advantage of its own experience in the use of electric vehicles, for it has 16 electric delivery wagons in operation, the Commonwealth Edison Company of Chicago is making a well-considered effort to encourage the use of electric automobiles, to the end that the consumption of electricity for battery charging may be increased. Careful records have been kept to show the expense of operation and maintenance of electric power wagons by the Commonwealth Edison Company, with the result that the cost of operation has been found to be less than that of horse-drawn vehicles of similar capacity. Business men realize that something must take the place of horse delivery on city streets, and the number of commercial electric vehicles is steadily increasing. In the last 30 days orders have been placed by Chicago merchants for 25 commercial electric vehicles.

In the past, a great mistake has been made in not giving proper attention to the care of the batteries of electric vehicles. Cases have been known, and that, too, in the case of rigs owned by electrical concerns, where the wagons have broken down, and on examination it was found that the electrolyte had entirely dried out. The electric vehicle has been blamed often where, as in this instance, the fault lay entirely in the utter lack of care of the battery. In former years, the electric automobile has been given a bad name from causes such as these. It is also true that in some cases the wagons themselves could be improved in design and construction, but vehicles of several makes are now available that are carefully designed and built.

Owners are beginning to realize the fact that the battery needs attention. The care of a vehicle battery is not specially complicated, but there are some things that must be looked to, and these are essential for good service. The specific gravity of the electrolyte must be maintained up to the standard, the loss by evaporation must be replaced by pure water, the batteries must be kept clean by being flushed perhaps once a week; they should not be allowed to stand completely discharged, and the charging and discharging, but more particularly the charging, must be attended to with some care. Some one man should have charge of the battery charging when it is done on the customer's premises. One cause of failures in the past has been that nobody in particular was in charge of this work, and this fact, together with ignorance of the construction and proper use of the battery, has made a great deal of trouble.

To encourage the extension of electric vehicle business, the Commonwealth Edison Company has organized a division of its contract department to devote its attention exclusively to this work. Mr. L. E. Marshall has been appointed to have charge of this division, and he has the co-operation of Mr. R. Macrae, battery expert. The activities of this vehicle division are of considerable interest. For one thing, it is preparing a map showing all public garage charging stations in the city of Chicago and also its own substations where electricity is supplied for charging vehicles. Ten thousand of these maps are being printed, and they will be presented to owners of electric vehicles without charge. It is thought that there are about 2500 owners of electric vehicles in Chicago. By the use of this map (which is divided in half and printed on both sides of the sheet to save space) the driver can tell at a glance the location of the nearest charging station in any point in the city in which he may happen to be at the moment. Furthermore, the stations are numbered, so that he can ascertain by referring to the margin of the map the character of the garage or substation, and he can determine where he wants to go. For instance, if the battery is nearly exhausted toward the middle of the day, the driver can make his way to the nearest charging station and get enough energy put into the battery during the noon hour to take him back home. The map also shows the best paved streets for vehicles—the "good roads," in other words—and altogether should be extremely useful to electric vehicle owners and their drivers.

The company is also sending out circular letters to vehicle owners to the effect that the Commonwealth Edison Company wishes to advise and help them in the practical problems of electric-vehicle operation. It is stated that the company has a battery expert who will examine customers' batteries, taking them apart if necessary, and carefully replacing the parts in the condition found. This expert (Mr. Macrae, who has had a number of years' experience in practical storage battery work) will make a report to the owner and there will be no charge for this service. For complaints coming from owners using public garages, provision is made to take the rig to a substation of the Commonwealth Edison Company where accommodations for the examination and testing of batteries are provided. In general, the company, through this new division, will be glad to give advice on the general characteristics and performance of electric vehicles, whether used for pleasure riding or for commercial purposes. Such matters as the proper rating of batteries, the mileage per day, manner and methods of charging, the use of rectifiers, best methods of obtaining the desired service from the vehicle, etc., will be discussed without charge. The company is interested simply in selling electricity, and, therefore, its advice to vehicle owners, to the end that their rigs may give more service, will be entirely disinterested.

At the coming Chicago Electrical Show of Jan. 15 to 29 the Commonwealth Edison Company will exhibit a model electric garage and will illustrate particularly the charging of vehicles from alternating-current service, using both the single rectifier and the six-circuit public garage type of rectifier. The latter is comparatively new and this demonstration at the Electrical Show will have a distinct educational value, showing that a number of batteries can be charged at one time from one source of alternating-current supply. One of the Commonwealth Edison electric delivery wagons will be shown, and there will be four or five crates of cells, such as are used in various types of vehicles, which will be employed to illustrate the combinations in use by the six-circuit charging board.

It is believed that a decided expansion of the use of electric vehicles is impending. It is probable that central stations, at least in cities of over 15,000 population, with well-paved streets, and in many cases in smaller places, can well afford to encourage this development. In Chicago, at any rate, after a careful consideration of the subject, it has been concluded that this business is well worth going after. It is thought that the prospects are good if the existing and prospective demand is carefully studied, and intelligent, systematic effort is devoted to the encouragement of the business.

ELECTRICAL REFRIGERATION BUSINESS.

A Dealer in Butter and Eggs Adopts This Very Successful Method.

By R. L. Lloyd.

THE butter and egg dealer is among the class of business men who are dependent on refrigeration for the preservation of their wares. He has formerly always been a victim of the ice famines, but, along with his brother ice buyer, is adopting artificial refrigeration to his decided advantage. The case cited below, which is by no means an isolated one, serves well to show what may be accomplished by an electrically driven refrigerating machine.

C. C. Hartman's Sons have a retail business in butter and eggs in Philadelphia. The majority of their sales are conducted from wagons which leave the store in the morning and are gone all day, delivering the goods to residences, etc. The ice formerly required averaged five tons per week during the warm season. A maximum of 10 tons for a week has been necessary in very hot weather, the total for the year amounting to about 160 tons. In 1908 the ice cost 15 cents per 100 lb. The best quotation that could be obtained for 1909 was 30 cents per 100 lb. A refrigerating machine had been under consideration for some time, and the increase in the price of ice was the final argument necessary to close the deal.

is being told him, misrepresentation, the third reason, will easily be taken care of.

The plants now on the market are of three different styles, namely, the hollow-wire system which generates the gas at the lamp, the hollow-wire self-generating system and the hollow-tube self-generating system. The first mentioned is not a success on account of the trouble and danger encountered every time the lamps are lighted and are seldom found in a city where any other form of lighting can be had. Leaks occur in this system frequently because of the difficulty experienced in properly brazing the joints. A too high pressure frequently opens the joints or forces the gasoline through the burners where it becomes ignited and falls to the floor or whatever happens to be underneath. Broken glassware is a source of great annoyance because of the intense heat to which it is subjected.

The hollow-wire and hollow-tube self-generating systems are founded upon the same general principle—that is, the gasoline is stored in a tank outside the building and is carried through a hollow wire by means of high air pressure to a small metal box inside the room to be lighted. In this box is a carburettor and burner which generates the gas. In doing this, the danger has been made two-fold, for an explosion may occur at this point caused from an excessive flow of gasoline, and in the event of such an explosion, it would probably occur while someone was lighting the generator or adjusting some part of the mechanism. There is usually supplied at this point a vent pipe which is supposed to carry off an overflow of gasoline. The pipe is left open a foot or two from the burner, and if an occasion ever arose for its use, gases formed by the escaping gasoline coming in contact with the air would spread to the lighted burner and explode. The tank and air pump being placed in the basement under the sidewalk or some other place where access is difficult makes it very inconvenient and hazardous should the gasoline supply give out or the valves become leaky after dark.

The first cost of the above-mentioned plants varies according to the make and size. A 10-lamp outfit ranges in price from $60 to $175. The average life is only two years and as a second-hand appliance it has little or no value. In figuring depreciation one can safely count them a total loss in two years' time.

The cost of operating the self-generating style, where a single-mantle, 80-cp lamp is used, is, when new and in perfect working order, ⅔ cent per lamp per hour. In less than six months, this figure will increase to ⅞ cent per lamp per hour. The maintenance will average about $1 per month.

The danger caused by the flimsy manner in which most plants are installed and the light material used in construction, will, when pointed out to the prospective buyer, cause him to hesitate, for it is not only property he is jeopardizing, but human life as well.

Filling the tank after dark is always dangerous and, no matter how careful one may be, this is sometimes necessary unless a gas or electric equipment has been installed for auxiliary lighting. In every gasoline permit issued by the insurance companies a clause is to be found reading as follows: "Never forget how dangerous a material you are handling, a little carelessness on your part may hazard your life as well as your property."

Insurance companies throughout the country consent to the placing of gasoline lighting systems in buildings covered by their policies without any increase in the premiums, but they require that a permit be issued which contains clauses that are almost impossible to live up to. It is claimed by one that has given the matter close investigation that all special gasoline lighting clauses are so framed that it can be proved that 90 per cent of the accidents arising are caused by violation of the terms; and if the insurance company so elects, the claim can be legally repudiated. The companies fully understand that they do not hold themselves liable for fires caused by explosion nor where explosion results from fires such as the striking of a match, a lighted stove, a burning gas jet or similar cause. It is a good policy for the solicitor to see the owner of the building where gasoline is to be used by a tenant, for any violation of the National Board of Underwriters' Code invalidates the policy of the owner as well as that of the tenant.

Fires caused by gasoline are very hard to extinguish. The vapor from one pint will render 200 cu. ft. of air explosive, and when such an explosion occurs, everything within reach is split and torn in such a manner that fire quickly gains headway. Burns caused by gasoline are always very painful and sometimes fatal. The lives of people in the building are often sacrificed, as the gas from escaping gasoline may be exploded from a cigar-lighter or lighted match some distance away from the pipe or the receptacle from which the liquid is escaping. The local fire department will always co-operate with the central-station solicitor in stamping out this evil, for no one realizes more than do the firemen the many risks that go with it.

Fatal accidents are an everyday occurrence. The daily papers give accounts of large fires and many deaths caused by exploding gasoline. Many of the articles will show that the damage was not only to the building, but that passers-by or people who happened to be on the premises at the time have been killed or injured. This result always means damage suits or great expense in settling claims. Such accounts, when cut out and kept in a book for that purpose, will be found to be of great assistance as a reference when writing personal letters to a prospective gasoline user.

The Standard Oil Company, realizing its responsibility and knowing the danger from gasoline for some years, printed the following on its billheads:

"Gasoline—not sold for illuminating purposes in houses.

"Caution: Gasoline is very inflammable and great care should be observed in the handling and storage of it. The package in which it is contained should be kept out of the house, away from the air, and the contents should never be drawn except in the daylight."

Many people are deathly afraid of gasoline. The leading hotels and business houses throughout the country give gasoline plants a wide berth. Proprietors of theaters, hotels and rooming houses, realizing the many dangers that such plants bring into their immediate vicinity, will often use their influence and do all in their power to keep these plants out of the neighborhood.

All gasoline plants are complicated, and unless carefully inspected at frequent intervals by an expert in that line, serious trouble will develop. The average man who burns gasoline, and in fact most of the men installing gasoline systems, do not fully understand their appliance. Water in the gasoline, intense cold and leaky air valves have a bad effect upon the generator. If a poor grade of gasoline is used a carbon deposit forms at the burner, thus cutting down the candle-power. Poor gasoline gives off an odor which is very offensive. Where the run of tubing is very long condensation takes place and the moisture flows into the fixture, which acts as a trap, shutting off the gas supply. The vapor of gasoline may be carried by a draught or current of air, and thus be brought into contact with fire at considerable distance; consequently, gasoline should never be opened or poured from one vessel to another in a current of air.

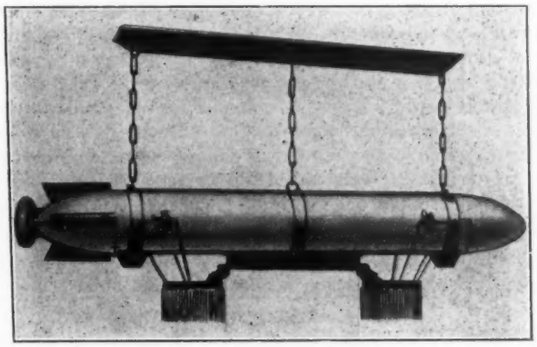
The intense heat given off from any kind of gasoline lamp renders it impractical for window lighting, and when used for general illuminating purposes only, frosted windows must be contended with in cold weather. This heat also makes gasoline very unsatisfactory for saloons, drug stores, markets and candy factories. In such places the additional cost incurred for ice and electric fans dissipates any saving there might be in favor of such a system. The damage done to the stock and the dissatisfaction caused among the patrons are not small items.

Where gasoline lighting of any sort is used, the cost of keeping the ceiling and interior decorations neat and clean will advance 100 per cent. Where artistic fixtures and arrangement of lamps are required, satisfaction cannot be given by gasoline lamps.

Wiring and Illumination

A ZEPPELIN ELECTRIC CHANDELIER.

A rather novel application of a modern dirigible balloon for illuminating purposes is shown in the accompanying illustration. The designer is no less a person than Count Zeppelin, the famous aeronaut, who recently was chosen godfather for the heir of the Crown Prince of Germany. The Crown Prince had made several trips in Zeppelin dirigibles and in casting about for a suitable gift for the young heir the



Zeppelin Electric Chandelier.

Count hit on the idea of a miniature airship built to serve as an electric chandelier. The chandelier has a length of 1 m and is suspended on three chains which act as conductors of electricity. Two incandescent lamps are fitted in the main body of the balloon and two in the cars, the latter consisting of fine ground-glass prisms. In order that no details should be missing care was exercised in affixing the connecting gangway, steering fins, main rudder, propellers, etc. The design is made of polished white metal and frosted glass, and when the lamps are lighted a very pretty effect is obtained which adds to the uniqueness of the entire arrangement.

SPECIAL HOUSE-WIRING PROPOSITION WITH TUNGSTEN LAMPS.

Observing that quite a number of people owning or occupying moderate size houses were desirous of using electricity, but balked at the installation cost, Mr. Walter P. Schwabe, general manager of the Northern Connecticut Light & Power Company, of Windsor Locks, Conn., reasoned that if his company brought to the attention of these people the reduction in cost of electric illumination by the use of tungsten lamps and at the same time made them an attractive proposition for wiring the houses, his company could get the business. Subsequent results proved the soundness of this reasoning.

In the territory supplied by the company there are two electrical contractors, and before making any proposition to prospective customers, the lighting company sent the following letter to each contractor: "We propose to take up a campaign for residence lighting, and it is our plan to offer to wire houses for a fixed price, work consisting of seven outlets with 10 lamps, wiring, fixtures, shades and lamps complete. The seven outlets will be in adjoining rooms and there will be a ceiling outlet in the parlor, one in the dining-room, one in the hall, another in the kitchen and one on the porch. Two rooms upstairs will have side brackets. We will supply you with the parlor fixture, dining-room fixture, hall ceiling receptacle and the two upstairs brackets. Kindly quote us your lowest fixed price for wiring as stated above, including the assembling and hanging of the fixtures furnished by us. The work must be done in accordance with the rules and requirements of the National Fire Underwriters and those of this company. It is our intention to refer customers that desire additional work done in connection with this offer directly to you, and in order to make this campaign a success, it will be necessary to do this work at as low a cost as possible. In addition to a low price, we intend to offer to do this work on installment payments, and also to offer a liberal cash discount in order further to make the proposition attractive."

From this it will be noted that the company was to supply the fixtures, brackets and receptacles and that the contractor was to do the assembling, wiring, hanging of the fixtures and attachments, etc. The intention of the company was to have the installation consist of one circuit using a three-lamp fixture in the parlor and a two-lamp fixture in the dining-room. A drop cord was called for in the kitchen, a pull-chain ceiling rosette with ball globe in the hall, thus eliminating wire for a switch, an ordinary ceiling rosette for the porch which was provided with a switch, and side brackets in two bedrooms.

Although the porch lamp was the most expensive to install, owing to the presence of a switch, this was specified in preference to an outlet in some other part of the house on account of its advertising value to the company. Prismatic glass shades were furnished with the fixtures and brackets, and clear-glass, 40-watt tungsten lamps installed throughout. The fixtures were low in cost, but neat in appearance, with arms bent to hold the lamp in a perpendicular position.

The contractors made a low price, expecting to get their profit out of additional outlets that would be wanted in connection with the installation. In all cases the customer made his own arrangements for additional wiring with the contractor and in nearly every case the customer had additional outlets provided. In a few cases the customer after taking up the

Use Electricity in Your Homes.

Owing to the great improvement in Electric Light that makes its use available for many people who never before thought they could afford it, and in order to give everyone an opportunity to take advantage of the comfort and economy afforded by the use of electricity, we make the following offer:

Clean, Safe, Economical.

SPECIAL HOUSE-WIRING PROPOSITION.

No Home, whatever its size, can afford to be without it.

We will wire houses located on our lines **With Seven Outlets and Ten Tungsten Lamps,** complete with fixtures and shades, located as follows. Parlor, three-light fixture; Dining Room, two-light fixture; First-floor Hall, one ceiling fixture; Porch, ceiling rosette with switch; Kitchen, one drop light; two Bedrooms, one bracket light each.

On account of the low price we offer, the bedrooms must be located directly above the rooms wired on the first floor.

We are ready to equip your home in a first-class manner, with wiring concealed as far as practicable, and as specified above, **for $45.00.**

You can pay us in easy monthly installments, or if you desire to pay within ten days of the completion of the work, we will give you **a Discount of $5.00,** making the exceptionally low price of

Don't Miss This Opportunity.

$40.00 For a Complete Electric Lighting Installation as above.

Write, Call or Telephone; first come, first served.

Northern Conn. Light & Power Co.

Advertisement for House Wiring Proposition.

matter of additional outlets with the contractor, dealt directly with him for the entire job and the offer of the electric light company simply acted to create the demand. This was perfectly satisfactory to the company which wanted the customer rather than the wiring contract and co-operated with the contractor in enabling him to secure the work.

The cost for the work is given on page 58.

The company offered to do the work for $40 on a cash basis or for $45 on an installment payment plan as per the accompanying advertisement which appeared in the local papers as soon as the company was ready to make the proposition. From this it will be seen that the company netted a trifle over cost on the installment plan and lost a few dollars on the cash pay-

ment basis. The discount for cash payment was offered, not only as an inducement for quick sales, but to add materially to the attractiveness of the proposition. In addition to the newspaper advertisement, a solicitor delivered folders to a

Two fixtures and two brackets	$3.35
One Hubbell pull socket	.60
One 6-in. ball globe	.10
Seven sockets and holders	.60
Eight Holophane shades	3.00
Ten 40-watt tungsten lamps	6.80
Contract price for wiring	28.10
Total	$43.45

select list of prospective customers along the existing electric light lines of the company. This brought the matter before each one personally and quick results were obtained.

WIRING FOR MOORE TUBE LAMPS.

Although used to a comparatively limited extent, the Moore tube lamps posssess certain advantages which are destined eventually to call for wider applications of this type of illuminant and hence to bring it within the wiring possibilities of the average electrical contractor. The lamp itself is of the vacuum-tube variety, the controlling apparatus being enclosed in an iron terminal box, and requires alternating current at 60 cycles and 220 volts for its operation. It is installed by the manufacturer so that the wiring contractor is only required to bring the 220-volt circuit close to the terminal box. The circuit should preferably terminate in a 25-amp, double-pole, fused, knife switch, the lamp requiring from 11 amp to 23 amp, depending on the length of the tube and the intensity of the light.

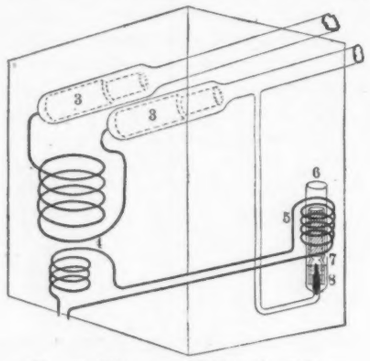
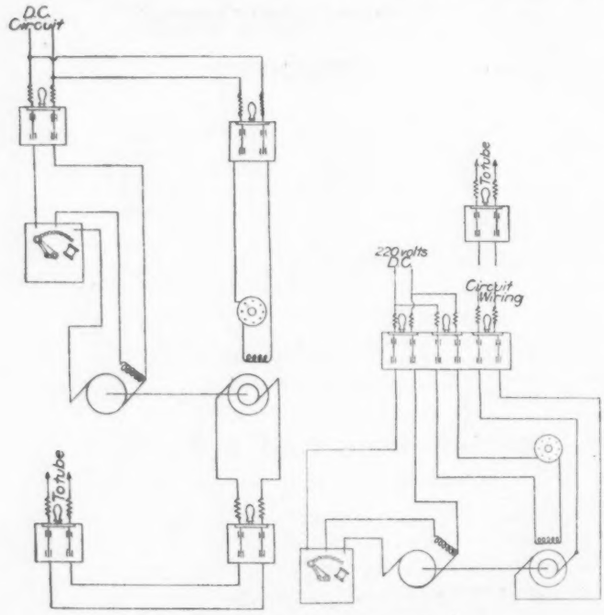


Fig. 1—Diagram of Terminal Box.



Figs. 2 and 3—Wiring Connections.

The apparatus in the terminal box is shown diagrammatically in Fig. 1. The carbon terminals, to which the high-tension sides of the transformer are connected, are shown at 3. The transformer is indicated at 4 and the primary side is connected to the 220-volt supply circuit. At 5 a solenoid is shown connected in series with the primary side of the transformer. The various parts of the solenoid valve used to regulate the supply of carbon-dioxide gas to the tube are indicated by the numerals 6, 7 and 8.

In wiring for the lamps it is best to use No. 10 wire, which has ample current-carrying capacity for the largest size of tube. Where alternating current is available it is a simple matter to get a potential of 220 volts either direct from the mains or through a transformer. If direct current only is available some kind of converting apparatus is necessary. Fig. 2 shows a diagram of connection where a motor-generator set is employed, and Fig. 3 gives a diagram of connections assuming that 220-volt direct current is available and that energy from this circuit is used for exciting the field coils of the generator. The apparatus used in making the connections is standard. It will be evident, therefore, that what would appear to be a complicated piece of wiring is in reality quite simple, and, in the case of a straight 220-volt, alternating-current service, is identical with that for any other type of lamp excepting as to the size of conductors necessary.

WASHINGTON STREET-LIGHTING.

Comparisons of Sources of Street Lighting Based on Out-Door Measurements.

IN a report of the electrical department of the District of Columbia, submitted by the electrical engineer, Mr. W. C. Allen, much information is given concerning street-lighting in Washington. Tests were made on typical street-lighting installations to enable their relative efficiencies to be compared and to aid in improving the lighting of the District.

Interesting comparisons can be drawn from tests made on two of the main thoroughfares leading out of the city. These two streets are quite similar in character, in amount of vehicular travel and in extent of improvements. They are both traversed throughout their entire length by trolley cars, with overhead center-pole construction outside of the city limits. In the case of Georgia Avenue there is a roadway on each side of the tracks; Wisconsin Avenue has only one roadway. In each case the trolley poles were considered the best place for the lamps, as large trees, telephone and telegraph poles and other obstructions made side lighting objectionable. From the Maryland boundary line southward for about three miles Georgia Avenue is lighted by 50 magnetite arc lamps, hung on every third or fourth trolley pole from 9-ft. mast arms placed parallel with the direction of the street. From the end of this circuit toward the city the lamps are of the constant-current, series inclosed type similarly suspended. The distance apart of the lamps varies from 300 ft. to 400 ft., the actual distance covered by the 50 magnetite arcs being 15,450 ft., or an average spacing of 309 ft. The actual distances between the lamps tested are 397 ft., 394 ft., 408 ft. and 394 ft. On Wisconsin Avenue, for a portion of the distance, 40-cp (100-watt) Gem filament, series-incandescent lamps are used, backed by the old-style hooded reflector placed on every trolley pole at a height of 15 ft. and turned toward the roadway. The other portion of the street has 40-cp (50-watt) tungsten series lamps, backed by radial-wave reflectors placed on every trolley pole, but in line with the direction of the street. There is a sidewalk on each side of the tracks where the lamps are hung in this manner, on which it was desired not to throw any shadows. As in the case of Georgia Avenue, the trolley poles average 100 ft. apart. The actual distance covered by the 77 Gem filament lamps is 7400 ft., or an average distance apart of 96 ft.

The illumination from the arc lamps was found quite intense for a distance of 40 ft. on either side of the lamp and then falling off rapidly until, at about 75 ft. from the lamp, it equals

the average values obtained from either the tungsten or Gem filament lamps. For a distance of 250 ft. more (or to a point 75 ft. from the next arc lamp) the illumination is fairly uniform, but slightly less than the average from the incandescent lamps. To the eye the lighting in the latter case is far more pleasing and effective than in the former, and it has the added advantage of actually costing only 0.249 cent per foot of street against 0.275 cent for the former—about 10 per cent less. A still greater advantage is in the matter of outages. The extinguishing of one arc lamp where the spacing averages from 300 ft. to 400 ft. seriously interferes with the effectiveness of the lighting, while a similar occurrence with the incandescent lamp is hardly noticeable.

A summary of the tests on these two streets is given in Table I.

TABLE I.—COMPARISON OF ILLUMINATION.

Kind of Lamp—	Distance considered.	Distance between lamps under test.	Foot-candles. Maximum.	Minimum.	Average.	Average variation from mean (%).
Georgia Avenue—						
Magnetite	400	388	0.380	0.005	0.062	106.6
Series inclosed	400	400	0.177	0.003	0.036	106.9
Wisconsin Avenue—						
Gem series	90	113	0.016	0.004	0.012	29.6
Tungsten series	100	100	0.021	0.007	0.013	33.0

The annual cost of lighting per foot of street and certain physical data as to heights of lamps, width of street, etc., are shown in Table II.

Largely as a result of the tests indicated above, changes in the street-lighting installations have been made, as shown in Table III.

TABLE III.—CHANGES IN LAMPS.

Kind of lamp—	Added.	Discontinued.
Mantle gas	346	189
Naphtha	7	203
Flat-flame gas	—	15
Electric incandescent:		
25-cp, Gem filament	13	190
40-cp, tungsten	229	67
40-cp, Gem filament	3	44
50-cp, Gem filament	3	—
75-cp, tungsten	24	—
Electric arc:		
Direct-current multiple inclosed	42	50
Magnetite series	132	—
Series inclosed	14	6
Street designation lamps:		
On patrol post, gas	1	—
On plain posts, gas	—	2
On arc-light post, electric	—	1
Total	814	767

In discussing the estimate for appropriation for street lighting for the fiscal year ending June 30, 1911, Mr. Allen called attention to the fact that the presence of shade trees is a serious obstacle to the proper lighting of the streets. The common practice is to plant the trees from 12 in. to 18 in. back of the curb line and with an average spacing of about 28 ft. The position at the curb line is also the best for the lamp-posts; in fact, it is the only one, unless the center of the roadway be occupied. It has been the practice in the past to place the posts in line with the trees, thereby locating them where the greatest obstruction from the foliage results. The irregular spacing of the trees also prevents a uniform arrangement of the lamp-posts, while the practice of trimming the trees so low still further obstructs the light. The extent to which the foliage interferes with the lamps is seen from the fact that in the summer of 1908 it was necessary to trim 9657 trees which were obstructing 5946 lamps. Two years previously 5467 trees were trimmed around 2860 lamps. This trimming was in both cases in addition to that regularly done by the superintendent of parking and trees. A great deal of this interference could be avoided (on streets already provided with trees and lamps) by narrowing the roadways, thereby enabling the department to move the lamp-posts out to the curb line and leave them clear of the trees. This was done in a few instances until the changing of the width of the roadways was prohibited by act of Congress. Where such changes were made, the lighting was greatly improved and the obstruction of the lamps by the foliage reduced to a minimum.

At street corners it is found in many instances that the trees are placed so close to the intersecting curb line that a lamp-post cannot be located at the apex of the corner without either

TABLE II.—COST OF LIGHTING.

KIND OF LAMP	Height of Lamp Above Pavement	Distance of Line of Lamps From Line of Test Stations	Width of Street	Width of Roadway	Location of Lamps	Average Longitudinal Spacing of Lamps Throughout the Street	Cost per Foot of Street
	Ft. In.	Ft. In.	Ft. In.	Ft.		Ft.	
Direct current multiple inclosed arc	17 10	25 0	133 0	60	At curb on one side	160	$0.53
Incandescent electric clusters *a*	*b* 15 7	.. ..	.. ..	..	..	....	....
Direct current multiple inclosed arc	17 6	42 0	85 0	50	At curb on both sides	....	....
Direct current multiple inclosed arc	17 6	81 0	85 0	50	At curb on both sides	175	.478
Direct current multiple inclosed arc	17 6	59 0	85 0	50	At curb on both sides	....	....
Direct current multiple inclosed arc	17 6	9 0	85 0	50	At curb on both sides	....	....
Magnetite series arc lamps	21 0	22 0	90 0	60	Center of roadway	309	.275
Direct current series inclosed arcs	21 0	22 0	90 0	60	Center of roadway	309	.275
Magnetite series arc lamps	16 6	15 0	130 0	45	At curb on both sides	200	.383
Direct current series inclosed arc lamps	16 4	17 6	160 0	50	At curb on both sides	173	.462
Direct current multiple inclosed arcs	.. ..	17 0 72 0	160 0	105	At curb on both sides	94	.90
Direct current multiple inclosed arcs	.. ..	52 0	160 0	105	At curb on both sides	....	....
Direct current multiple inclosed arcs	.. ..	72 0 17 0	160 0	105	At curb on both sides	....	....
4-glower Nernst	17 0	26 0	52 0	..	Both sides at railing	(*c*)	2.362
100-watt Gem multiple incandescent	12 0	36 0 10 0	46 0	..	Both sides at railing	....	....
100-watt Gem multiple incandescent	12 0	10 0 36 0	46 0	..	Both sides at railing	76	.648
100-watt Gem multiple incandescent	12 0	10 0 36 0	46 0	..	Both sides at railing	....	....
100-watt Gem multiple incandescent	12 0	10 0 36 0	46 0	..	Both sides at railing	....	....
100-watt Gem multiple incandescent	12 0	12 0 48 0	12 0	60	Both sides at curb	80	.316
100-watt Gem multiple incandescent	12 0	48 0 12 0	120 0	60	Both sides at curb	....	....
60-watt tungsten lamps	14 0	15 0	90 0	30	Both sides at curb	85	.452
60-watt tungsten lamps	14 0	15 0	90 0	30	Both sides at curb	....	....
100-watt Gem series	15 0	22 0	.. ..	30	At curb one side only	96	.252
60-watt tungsten series	16 0	25 0	.. ..	30	At curb one side only	96	.252
Mantle gas lamps	8 6	20 0	160 0	40	At curb both sides	67	.321
Mantle gas lamps	8 6	20 0	160 0	40	At curb both sides	67	.321
Mantle gas lamps	8 6	20 0	160 0	40	At curb both sides	67	.321
Mantle gas lamps	9 7	25 0	160 0	50	At curb both sides	114	.182
Direct current multiple inclosed arcs *a*	.. ..	.. ..	.. ..	..	..	....	....
Mantle naphtha lamps	8 6	25 0	110 0	50	At curb one side only	120	.190
187-watt Gem multiple lamps	10 6	22 6	45 0	..	Both sides at railing	115	.712
187-watt Gem multiple lamps	10 6	22 6	45 0	..	Both sides at railing	115	.712

a Special installation. *b* Average. *c* Special.

a lightning surge originated at a point along the line about a mile from the station, the iron wire might for all practical purposes be copper, as far as protection is concerned.

Another point which suggests itself is, that when discussing a choke coil for use against lightning surges, it means very little to state its inductance only. The currents passing through different cross-sections of the conductor of such a coil at the same instant will be very different on account of capacity effects (see Steinmetz, "Transient Phen.," page 346), and this means that the coil will radiate a lot of energy into space when subjected to an e.m.f. of lightning frequency, although not as much as a straight antenna would send out; moreover, its inductance at such frequencies is altogether different from its inductance at machine frequencies. When describing such a coil, its resistance and inductance as measured by a current at, say, 500,000 cycles, should be specified, as otherwise entirely misleading results may be deduced from the data.

VANCOUVER, B. C. G. B. EHRENBORG.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Short-Circuited Rotors.—K. SIMONS.—An illustrated article in which the author first criticises former methods for determining the distribution of the current in short-circuited armatures. He shows that the conception of a stray field and of the primary and secondary stray fluxes and their application to the calculation of the short-circuited voltage are rendered valueless in transformers with windings connected in parallel. In such cases it is necessary to base the calculation on coefficients of induction. The same statements are then proved to hold true for short-circuited armatures of induction motors and formulas are given for the exact calculation. However, the evaluation of these formulas is rather complicated. The author, therefore, describes an experimental method for measuring the relative value and the phase difference of the starting currents in short-circuited armatures.—*Elek. Zeit.*, Dec. 16.

Induction Coupling.—H. ZIPP.—A theoretical article in which the author gives a graphical method for explaining by means of diagrams the behavior of an induction coupling. The problem is first solved under the assumption that there is no stray field and, second, under the assumption of a stray field. It is proposed to apply the same method to the theory of the induction motor whereby the Ossana diagram is to be derived.—*Elek. Kraft. u. Bahnen*, Sept. 14 and 24.

Split-Pole Converter.—A note on a recent British patent (24,854, 1908; Dec. 9, 1909) of the British Thomson-Houston Company and F. P. Whitaker. The auxiliary poles of a split-pole converter have a series winding both for producing a commutating field and for changing the ratio between the alternating-current and direct-current volts, to give a compounding or over-compounding effect at full load. The brushes are given a backward lead, thus allowing the auxiliary pole flux to add to the main-pole flux at full load, but the lead is not sufficient to remove the coil under commutation from the influence of the auxiliary pole.—Lond. *Elec. Eng'ing*, Dec. 16.

Synchronous Converter.—GROSS.—An illustrated description of an 800-kw, 50-cycle synchronous converter at the Bochum municipal lighting plant, in Germany. This is chiefly interesting because in the past synchronous converters have been very little used in Germany as compared with the United States, chiefly because in Germany a frequency of 50 is preferred for combined lighting and industrial service.—*Elek. Kraft. u. Bahnen*, Oct. 24.

Lamps and Lighting.

Metallic-Filament Lamp.—A note on a recent British patent of J. Meszaros (667, 1909; Dec. 2, 1909). A hollow, thin glass cylinder or cone, silvered on the interior, is supported on the central glass rod between the collars from which radiate the filament supports. The cone is thus fixed in the interior of the filament cage and reflects in all directions. The central rod is rigidly fixed to the base, but connected to the lamp tip by a spring.—Lond. *Elec. Eng'ing*, Dec. 9.

Metallic-Filament Lamps for Tramway Cars.—Metallic-filament lamps have not proved successful in the past for street-railway car lighting, as they have there too short a life, chiefly on account of the mechanical vibrations of the car and the rapid voltage variations. Tantalum lamps have, however, been recently developed specially for this purpose and are proving successful in practice, although they have a somewhat higher specific consumption than the ordinary tantalum lamp; the consumption is 2 watts per hefner candle. They are in use on various German street railways, and 48 lamps which have been under control have shown so far a mean life of 785 hours; of these, 18 lamps are still burning, so that finally a mean life of over 800 hours is to be expected from this batch of lamps. Of these lamps 26 had a life of from 1000 hours to 1650 hours. Curves are given showing the comparative cost of tantalum and carbon lamps for street-car lighting. A tantalum lamp of 600 hours' life is found to be more economical than a carbon lamp of 800 hours if the price of electrical energy is more than 1⅝ cents per kw-hour.—*Elek. Kraft. u. Bahnen*, Nov. 21.

Arc Lamp.—A. PLANCE.—An illustrated description of the "Tetra" lamp, which is operated four lamps in series without any series resistance on 110-volt circuits with alternating current or direct current.—*La Lumière Elec.*, Dec. 11.

Flame-Arc Lamp.—An illustrated description of the "Beacon" flame-arc lamp made by a British company. It is a converging-electrode flame-arc lamp and has a compact feeding mechanism without any clockwork. A step-by-step feed is effected by a ratchet wheel alternately released by two pawls. Provision for a complete release of the wheel to bring the electrodes together and restrike the arc is also made.—Lond. *Elec. Eng'ing*, Dec. 16.

Measurement of Light Efficiency.—C. C. HUTCHINS.—An article in which the author proposes a new method of measuring light efficiency. Fig. 1 represents the energy curve of the light

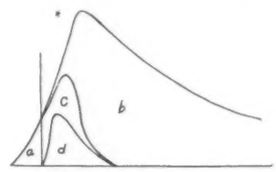


Fig. 1—Energy Curve.

source; the vertical line separating the visible a from the infra red b. If now efficiency be defined as the ratio of the visible to the total radiation, then efficiency $= a/(a+b)$. A water cell a few millimeters thick is then placed in the path of the light. Assuming that the water is perfectly transparent to light, $a+c$ becomes the transmitted energy, the curve coming down to zero at wave-length 1.8μ. A cell identical with the water cell, but containing a water solution opaque to light, but transmitting more or less infra red (best a potassium permanganate solution) is then interposed; the transmitted energy is d. The transmission curve d must lie within the same narrow limits with c, and the two areas must be strictly comparable under like conditions. If now, $a+b$, $a+c$, d can be measured, the ratio of c to d is all that is required. For if $a+b=n$ and $a+c=m$ and $c/d=r$, then $a/(a+b)=(m-dr)/n$. The method was applied to the test of a portable acetylene lamp, two determinations giving efficiencies of 0.0296 and 0.0323. Nichols and Coblentz found by other methods 0.033 and 0.030.—*Amer. Jour. of Science*, December.

Modern Illumination.—L. GASTER.—The conclusion of his Canton lectures on modern methods of artificial illumination.

interfering with a sewer catchbasin or obstructing the cross-travel on the sidewalk. As the corner lamps are by far the most important, it is necessary that such places should be kept clear of trees.

During the past winter several experiments were tried with electric incandescent and arc lamps on residence streets, with a view to their possible use in such localities. The former lamps were placed in various kinds of opal and frosted globes on the top of iron posts on Massachusetts Avenue between Seventeenth and Eighteenth streets, with a spacing of about 60 ft., measured along the axis of the street. They were located at the curb line on both sides of the street in line with the trees for a distance approximately 1000 ft. Forty-cp tungsten lamps were used, at a height of 10 ft. above the pavement. They gave a very uniform illumination on the street, apparently of greater intensity than the similar installation of mantle-gas lamps on Massachusetts Avenue west of Rock Creek. The appearance of the luminous globe was far more pleasing than the type of lantern in use on the existing mantle-gas lamps with the bare, unprotected mantles.

Experiments with arc lamps for residence streets were made during the month of March, 1909, on Massachusetts Avenue, from Ninth to Fourteenth streets, a distance of 2300 ft. Here lamps of the multiple-enclosed type were placed on the top of temporary wooden posts located on "isles of safety" in the center of the 50-ft. roadway. These temporary isles consisted of boxes 4 ft. square and about 8 in. high, filled with sand. In a permanent installation of this character these isles would not be more than 3 ft. in diameter and would be constructed of circular stone curbs with the enclosed space filled with a cement pavement. Opal globes were used, placed 15 ft. above the pavement. The average distance between posts was 135 ft. With this arrangement of lamps the illumination was very uniform and the light on the sidewalks bright and well diffused, with a noticeable absence of deep shadows. The only change to be made, if such a system were adopted, would be to place the lamps about 2 ft. higher above the pavement. The results from these experiments were highly satisfactory and demonstrated that this is the most feasible way of lighting the more important streets in the city where trees are planted at the curbs and where the roadways are 50 ft. or more in width. Mr. Allen stated that he would not advocate placing lamps, as a general rule, in the center of roadways where the width is less than 50 ft., nor where the street has no trees.

A SOUTHERN FLASHING SIGN.

The accompanying illustration shows a roof sign recently connected to the circuits of the Montgomery Light & Water Power Company, of Montgomery, Ala. The sign, which advertises a brand of syrup manufactured in the South, contains in

A Southern Flashing Sign.

all 1000 lamps which flash on and off. The border is made up of red-colored lamps, and is connected to give a linked-belt effect. Mr. George Williams, of Messrs. Henry L. Doherty & Company, is credited with the statement that since the sign has been in operation the demand for the product advertised has more than doubled in Montgomery and the surrounding towns.

LIGHTING PICO STREET, LOS ANGELES.

Work will soon be begun on the installation of 188 ornamental lamp-posts on Pico Street in Los Angeles, from Main Street to Vermont Avenue, a distance of about two miles. Each post supports five 100-watt tungsten lamps in frosted-glass globes. Four of these are supported on brackets near the top of the post and the fifth lamp is higher than the others and surmounts the post itself. The post is of iron and of handsome design. It is spoken of as a Roman column, and at street corners will bear signs giving the names of the streets, placed where a strong light will shine upon them. The four bracket lamps will burn from dusk until midnight and the top lamp will burn all night. The majority of the property holders on Pico Street, between Main Street and Vermont Avenue, petitioned the City Council to order the work of installing these lamps done under the assessment-district plan, and this petition was granted. It is said that property owners along Pico Street, west of Vermont Avenue, are considering the extension of the system west to the city limits.

LETTER TO THE EDITOR.

Protection to Station Apparatus.

To the Editor of Electrical World:

SIR:—In an article entitled "Protection to Station Apparatus," in your first issue for December, 1909, the author suggests that the choking coils commonly used in conjunction with lightning arresters be superseded by replacing the copper wire in the high-tension circuit between the transformers and the lightning arresters by ungalvanized soft-iron wire, for the reason that, owing to the high frequency of a lightning discharge, the high skin effect of the iron wire would choke down the rise of potential about as efficiently as would an ordinary coil. I am not in a position to dispute this statement in toto, as I have no numerical data as to the behavior of choking coils at these high frequencies, but I would submit that there is no appreciable advantage in replacing the copper with iron.

To take the case of a transmission line, it makes no difference to the present argument whether the line is carrying its ordinary load or not, since two currents of different frequencies in the same conductor ignore each other altogether. Suppose a high-frequency surge is generated at some point; the line may then, as far as this surge is concerned, be considered as a sending antenna for wireless telegraphy—that is, will radiate energy into space. This means that besides the ohmic resistance of the wires (which includes skin effect) there will be an apparent resistance (not a reactance); in other words, for a given current more power e.m.f. must be applied to the wire than the ohmic resistance would account for, and the size of this apparent resistance (which is independent of the material of the conductor) is what makes it useless to put in iron wires instead of copper.

In his book, "Transient Electric Phenomena and Oscillations," page 407, Dr. Steinmetz goes fully into this matter and gives formulas for the two kinds of resistance mentioned. Taking his numerical example and comparing No. 4 copper wire with No. 4 iron wire (permeability 2000), there are obtained the following values, expressed in ohms per meter:

	500,000 Cycles		1,000,000 Cycles	
	Copper.	Iron.	Copper.	Iron.
Ohmic resistance, including skin effect	.011	1.167	.0155	1.65
Apparent resistance	.985	.985	1.97	1.97
Reactance	.897	2.053	1.63	3.26

It will be understood that no great accuracy is claimed for the values here given, but they afford a fair idea of the magnitude of the quantities concerned. They show that a certain length of iron will give only about twice as good protection as the same length of copper wire at these frequencies—that is, if

Wires, Wiring and Conduits.

Determining the Sag of Overhead Wires.—H. DREISBACH.—The sag of overhead wires may be easily determined by setting the wire by hand into regular oscillations and counting the number of the single oscillations per minute (a complete period being counted as two oscillations). If this number is n, the sag in centimeters is 447,300 divided by n^2. This formula is correct for all kinds of wires and for all distances between poles, since the formula depends neither on the mass nor on the length of the wire.—*Elek. Zeit.*, Dec. 16.

High-Tension Transmission.—E. W. MARCHANT AND E. A. WATSON.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The two great developments of recent years in energy transmission over long distances are at Niagara Falls and on the Pacific Slope of Western America. These schemes are outlined by the authors. Then they go into technical considerations in the design of transmission lines, as regards the limits of pressure, frequency, line protection, arrangement of lines and operation. Finally, they describe modern practice in connection with hydroelectric stations, the transmission lines and substations.—Lond. *Electrician*, Dec. 10.

Transmission-Line Construction.—H. KYSER.—The first part of a profusely illustrated article on the mechanical problems in transmission-line construction, giving data on the materials needed, methods of connecting lines, their strength, pole construction, etc.—*Elek. Kraft. u. Bahnen*, Sept. 24 and Oct. 24.

Cheap Wiring System.—A note on a recent British patent of J. S. Highfield (24,533, 1908; Dec. 9, 1909). The two insulated conductors are separated by a web of insulating material or tape, which is cut away at corners where the conductors are carried through a fitting of insulating material. The inner conductor is bent to take up the extra length. At joints separate metal connectors are pressed into contact with the bared conductors by means of split sleeves. These are corrugated or otherwise caused to make a good and fast connection by the use of a special pair of pliers, covered by one claim of this patent. —Lond. *Elec. Eng'ing*, Dec. 16.

Testing of India Rubber.—A. MARTENS.—The insulated wire and cable factories of Germany have jointly made an arrangement with the German Bureau of Testing Materials for the testing of india rubber for insulated wires and cables. An account of this arrangement is given concerning the scope of the tests, the expense and the methods of analysis agreed upon.—*Elek. Zeit.*, Dec. 16.

Electrophysics and Magnetism.

Thermoelectric Forces of Tantalum and Tungsten.—W. W. COBLENTZ.—The author has tested the suitability of tantalum and tungsten for thermoelectric purposes. Within the range of temperature investigated (from — 200 deg. C. to + 100 deg. C.) the thermoelectric force of tantalum against copper is about 4.1 microvolts per degree, which is one-tenth that of the copper-constantan couple. The direction of the current is the same as in the copper-constantan couple. The same investigation was made for tungsten and it was found that the curve of thermo-e.m.f. as a function of temperature has a maximum (an inversion point) of 40 deg. C. For temperatures below — 100 deg. C. the thermoelectric force (against copper) is about 3.5 microvolts to 4 microvolts per degree, while above + 200 deg. C. the thermoelectric force is about — 4.5 microvolts per degree, so that tungsten, like tantalum, shows no apparent advantage in thermoelectric work.—*Bull. Bureau of Standards*, Vol. 6, No. 1, October, 1909.

Positive Rays.—W. WIEN.—An account of a continuation of his researches on this subject. He concludes his investigation as follows: (1) The positive rays of hydrogen at high vacua are less strongly influenced by magnetic fields than at low vacua. (2) The rays which are weakened in a magnetic field are also weakened in respect to heat properties and light emission by a second magnetic field to approximately the same degree as those rays which have not been effected by the first magnetic field. (3) The light emission is under otherwise equal conditions much less in high vacua than in low, and this is especially true of hydrogen as well as air. (4) The magnetic influence does not depend to a large degree upon the potential difference exciting the tube. (5) The canal rays of quicksilver do not convey a traceable discharge, and no deflection can be observed in strong magnetic fields by direct observation of the light emission. (6) The paper concludes with reflections upon the possibility of combination and recombination of ions and electrons, and on the possibility of light being emitted by positive ions in a neutral condition.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Ratio of Charge to Mass of Electrons.—K. WOLZ.—The author has collected the various determinations of this ratio and used Bucherer's method for a new determination. He obtained $e/m = 1.7674 \times 10^7$, while Bucherer obtained $e/m = 1.763 \times 10^7$.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Aluminum-Copper Alloys.—W. BRONIESKI.—A paper read before the French Academy of Sciences giving diagrams for the conductivity and temperature-conductivity coefficient of the entire range of aluminum-copper alloys.—*L'Industrie Elec.*, Dec. 10.

Electrochemistry and Batteries.

Rapid Formation of Positive Lead Storage-Battery Plates.—G. JUST, P. ASKENASY AND B. MITROFANOFF.—A long account of an investigation of the possibility of accelerating the Plante formation of positive lead storage-battery plates by adding nitric acid or nitrates to the sulphuric-acid electrolyte. The extensive researches of the authors show that this is possible, although with plane surface plates the active mass formed does not stick, but has a tendency to drop off. However, with grids of large surfaces, as used in practice, the active mass becomes adherent. A concentration of 30 grams of potassium nitrate per 218 grams of sulphuric acid in the liter seems the best value.—*Zeit. f. Electrochemie*, Nov. 15.

Fusion of Carbon and Artificial Diamonds.—LA ROSA.—A paper in which the author first gives a résumé of the work of Despretz and Moissan on the production of artificial diamonds. He tried the effect of a high-tension spark on carbon dust which is suitably placed in a cavity of one of the electrodes of a singing arc. An e.m.f. of 300 volts was employed; a side circuit included a condenser of 60-microfarad capacity with very small resistance and self-induction. It was found that the temperature of the singing arc under the condition in which it gives the spark spectrum is much higher than that of the ordinary electric arc and the electric oven. The dust, after the operation, was carefully washed and treated in various solvents; finally, crystalline forms were obtained of great hardness. The paper contains photographs of these forms, which in the main were made up of two tetrahedrons with curved surfaces. The author suspects that he has obtained diamonds, and hopes to determine this question by further investigation.—*Ann. d. Phys.*, No. 12, 1909; abstracted in *Amer. Jour. of Science*, December.

Electrode Losses in Electric Furnaces.—J. FORSSELL.—A long account of an investigation of the best current density and best dimensions of electrodes for electric furnaces. The author comes in many respects to the same results as given in the recent papers of Hering and Hansen, but takes into account the leakage of heat from the electrodes sideways into the furnace wall.—*Met. and Chem. Eng'ing*, January. (*Metallurgical and Chemical Engineering* is the new title of the journal formerly published under the name of *Electrochemical and Metallurgical Industry.*)

Units, Measurements and Instruments.

Experimental Analysis of E.M.F. Waves.—P. G. AGNEW.—An article describing an approximate experimental method for the analysis of e.m.f. waves. It is based on the following principle: A distorted e.m.f. wave will pass more current into a condenser than a pure sine wave having the same effective value, since the effective rate of change of potential across the terminals of the condenser is greater for the distorted wave. This enables one to determine the amplitudes of the harmonics

In the present instalment the author deals with fixture design, street lighting, shop-window lighting, stage lighting, some physiological effects of different qualities of light, the distribution of energy in the spectra of illuminants, the efficiency of light production, and finally with ultra-violet light and the physiological effects produced by it.—Lond. *Electrician*, Dec. 10.

Illumination of the Floor.—J. Sumec.—A mathematical article in which the author shows how to find the illumination of the floor if the distribution of the candle-power around the lamp and the position of the lamp above the floor are known. The same method permits one to determine reversely the most favorable height at which lamps are to be suspended when the distance between the lamps is given.—*Elek. und Masch.* (Vienna), Dec. 5.

Traction.

Manchester.—An abstract of last year's account of the municipal tramway system of Manchester. The number of passengers carried during the 12 months was 155,011,884, compared with 151,477,138 in the preceding year; while the number of car-miles has also increased from 16,974,955 to 17,316,753. As the estimated population served is 850,000, the average number of journeys per head of population per year is now 182. The average fare paid per passenger was 2.38 cents, compared with 2.42 cents a year ago, but the revenue per car-mile has remained practically stationary, since the average number of passengers per car-mile was 8.95, compared with 8.92 last year. The total number of kw-hours used by the cars was 30,276,365, as against 29,955,070 units last year, the corresponding consumptions per car-mile being 1.748 and 1.76 kw-hours, respectively. The energy is purchased from the electricity supply department at 2.08 cents per kw-hour. The revenue per car-mile was 21.748 cents, while the total working expenses, excluding capital charges, were 14.086 cents per car-mile. The capital charges were 5.680 cents.—Lond. *Electrician*, Dec. 10.

Single-Phase Traction in Hamburg.—Freund.—A continuation of the very long illustrated serial on single-phase traction on the Blankenese-Ohlsdorf-Hamburg road of the Prussian State railway system. In the present instalment the description of the power house and of the substations is concluded. Details are given of the construction of the transformer, of the switchboard and of the transmission line. The serial is to be continued.—*Elek. Zeit.*, Dec. 16.

Monorail.—E. Eichel.—Some notes on the new monorail system recently proposed in a pamphlet of the German newspaper publisher, Scherl, and on the similar but older system of Brennan, the stability of both systems being based on the gyroscopic principle.—*Elek. Kraft. u. Bahnen*, Nov. 24.

Vienna.—K. Hochenegg.—An illustrated account of the projected electric underground railway in Vienna.—*Elek. Kraft. u. Bahnen*, Sept. 4 and 14.

Rail Welding.—Some notes on recent developments and modifications of the Goldschmidt process of rail welding by means of thermit. While it is generally used for welding the joints of the running rails of street railways, it has also been applied for welding the third-rail on the Paris Metropolitan Railway.—*Elek. Kraft. u. Bahnen*, Sept. 4.

Installations, Systems and Appliances.

Central Stations in the United States and Germany.—W. Fellenberg.—A second article on the development of electrical industries in the United States and Germany. In the development of central stations Germany has been left behind by the United States, partly on account of the relatively larger number of existing gas plants in Germany. In 1907 the number of electric central stations in Germany was 1530 and that of gas plants 791, the ratio of the former to the latter being 100 to 52. Even five years earlier the number of electric central stations in the United States in 1902 was 3620 and that of the gas plants 877, the ratio of these two figures being 100 to 24.5. In 1909 there were 351 cities in Germany which had both a gas plant and an electric central station. Naturally, if both are owned by the city, the city has an interest in not reducing the cost of the electric energy to too low a figure. Even in those German cities which own the gas plant, but do not own the electric central station, the municipal authorities reserve the right of determining the price of the electric energy in order to avoid too much competition with their gas works. Other German cities make a rather big profit from the privately owned electric central stations. For instance, the Berlin Electricity Works had to pay to the city of Berlin in the year 1908 taxes to the amount of $1,250,000. The gross profit of these works was $3,375,000, so that 37 per cent of the gross profit had to be paid to the city. It is hardly probable that the city could have earned the same amount of money if it had owned the electricity works. Diagrams are given showing the development of central stations in the United States and Germany, and various statistical data are summarized in tables, especially with respect to comparison of private and municipal ownership, capital invested and power factor. In the German municipal works the total yearly receipts averaged 16.05 per cent of the capital invested; in the German privately owned works, 14.63 per cent; in the municipal American works, 31.7 per cent, and the privately owned American works, 16.3 per cent; in all works of the United States together the average was 17 per cent. The mean values in the two countries agree, therefore, fairly well together.—*Elek. Zeit.*, Dec. 16.

British Central Station.—An abstract of last year's account of the Burton-on-Trent electric central station, which is specially interesting on account of the extensive adoption of metallic-filament lamps. This undertaking has now been in operation for about 15 years, and its progress has been fairly steady. It is, therefore, remarkable that the revenue from private lighting during the past year was actually less than the revenue obtained from the same source six years ago; this condition exists, notwithstanding that the lamp connections have increased by no less than 43 per cent during the last six years. A surplus has, nevertheless, been obtained. The number of kw-hours sold for private lighting was 317,129, compared with 335,550 units in the previous year; 1190 kw-hours were sold for public lighting, as against 1255 a year ago, while the sales of energy for motors, heaters, etc., totaled 553,390 and 15,159 kw-hours, respectively, compared with 401,690 and 10,694 kw-hours in 1908. In addition, 660,973 kw-hours were sold for traction purposes, an increase of 12,148 kw-hours, making a total output of 1,527,841 kw-hours, as against 1,398,014 recorded a year ago. The total cost, excluding capital charges, was 2.08 cents per kw-hour (against 2.12 cents a year ago). The total cost, including capital charges, was 3.66 cents (against 3.84). The total revenue was 3.92 cents (against 4.20 cents).—Lond. *Electrician*, Dec. 17.

Voltage Regulation for Alternating-Current Circuits.—E. Ruehle.—An illustrated review of voltage regulation for alternating-current circuits and of automatic devices for their operation, with special reference to the designs of the Allgemeine Elektricitäts Gesellschaft. Two different types are employed. In both types the excitation is obtained by means of a coil actuated either directly or indirectly by the main voltage, while the secondary gives the additional voltage. In one type, however, the additional voltage is changed by adding or cutting off some turns, while in the second type the additional-voltage coil is rotated in the magnetic field. The advantage of the first system is equality of phase of the regulating voltage with the central-station voltage so that there is no trouble in parallel operation. The disadvantage of this type is the complication of the switching arrangement. The advantage of the second type is the simplicity of the switching arrangements, but parallel operation is not possible without complicated devices, so that there are difficulties in connecting or disconnecting the regulator in operation. The author shows how these difficulties may be overcome. The article is profusely illustrated by diagrams.—*Elek. Zeit.*, Dec. 16.

Circuit-Breakers.—Henry.—An illustrated article giving brief descriptions of various automatic circuit-breakers made by European manufacturers and of relays used with them and operating on different principles.—*L'Industrie Elec.*, Dec. 10.

to which the distortion is due. In this case the absolute values of the e.m.f. across the condenser and of the current passing through it are measured. The necessity of knowing the absolute values of the current and voltage may be avoided by substituting a resistance in place of the condenser and adjusting its value to give the same settings on ammeter and voltmeter as were observed with the condenser. This is really making the ultimate measurement that of an impedance rather than that of

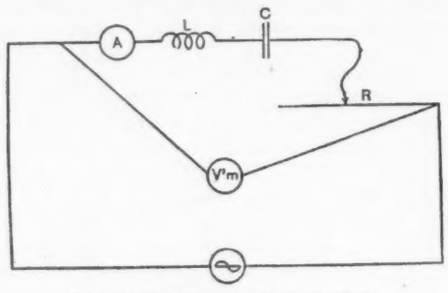


Fig. 2—Diagram of Arrangement.

the e.m.f. The arrangement is shown in Fig. 2, where *C* is the condenser, *R* a resistor of adjustable resistance, *A* an ammeter and *Vm* a voltmeter. For determining the fundamental and two harmonics it is necessary to make the test first with the condenser and the resistor in series; then with a second condenser of a different capacity, adjusting the resistance of *R* so as to get the same readings of voltmeter as ammeter; and, thirdly, to make the same test with the condenser short-circuited. The limitations of the accuracy of the readings limit the method practically to the determination of two harmonics. The accuracy of the method is intermediate between that of the curve tracer and that of the oscillograph and may be taken as 2 per cent or 3 per cent of the fundamental. It has the disadvantage of giving no idea of the phase relations, and hence of the form factor, and of not lending itself to the analysis of current waves, unless a considerable amount of energy is available. Its chief advantages are that no special apparatus is required and that the calculations are simple. In case it is desired only to know whether or not the wave is nearly pure all the harmonics may be lumped together and computed as if the third were alone present, thus still further simplifying the observations and computations. Another advantage of the method is that neither direct access to the generator nor the use of a synchronous motor is necessary, so that observations may be taken at a distance from the machine.—*Bull. Bureau of Standards*, Vol. 6, No. 1, October, 1909.

Capacity Standards for High Frequencies.—J. A. Fleming.—In his paper on measurements for wireless telegraphy he deals with standards of capacity for high-frequency currents. Glass, as well as hard rubber and mica are unsuitable. Even with air condensers there is some uncertainty. The author prefers condensers made with well-dessicated paraffin oil as dielectric having metal plates immersed in it as follows: Two rectangular sheets of stout zinc are bent around formers into square-cornered spirals, as shown in Fig. 3. The sheets are kept about 1 cm apart everywhere by four ebonite strips having saw cuts in them, which are fitted on the zinc sheets at the top and bottom, and connecting wires are also soldered to both sheets.

Fig. 3—Arrangement of Zinc Plates.

These sheets are placed in a sheet-zinc box and immersed in high-flash-point paraffin oil which has been treated for some days with fragments of metallic potassium or sodium to remove all moisture. Such paraffin oil has a dielectric constant of about 2.0 tested at low frequencies, and since its optical index of refraction is close to 1.41, its dielectric constant for optical frequencies must be near 2.0 and, hence, one may conclude with some confidence that its dielectric constant has also the same value for frequencies of the order of 1,000,000 or so. The low-frequency capacity may be determined at a frequency of 100 or 200 in the usual manner by charging and discharging the condenser through a calibrated galvanometer or by any of the bridge methods.—Lond. *Electrician*, Dec. 17.

Electricity Meters.—An account of the work of the Reichsanstalt in 1908 with respect to the test of electricity meters. The work was carried out by Schmiedel. Five direct-current and nine alternating-current meters were tested for friction by determining the number of revolutions which the armature would still describe after removing the brake-magnets and by other means. It was found that while the bearing and air friction essentially change with the speed, the friction of the brushes and in the counter is practically independent of the speed. This friction in the counter, however, varies a good deal in different meters; spur-gearing for the armature and wheel train seems to be preferable to helical gearing. It would also appear that the quotient of torque at full load to torque of total friction at full-load speed may be regarded as a criterion for the quality of the meter, but that the often stated quotient of torque at full load to weight of armature has no connection with the former quotient.—Lond. *Engineering*, Dec. 17.

Shunt for Large Alternating Currents.—In the testing work of the German Reichsanstalt currents of 18,000 amp have been necessary. Shunts for such heavy currents cannot be constructed on the ordinary bifilar plan without assuming awkward dimensions. Hence, the arrangement shown in Fig. 4 has been

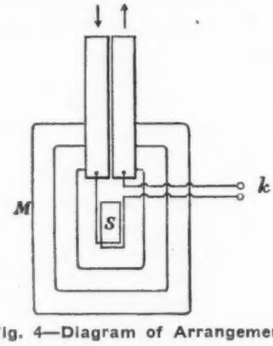


Fig. 4—Diagram of Arrangement.

adopted. The current leads are bifilar, but the manganin body *M* consists of several sheets in parallel, between which petroleum circulates. A coil *S* is inserted into the one potential lead; it is brought into the field produced by the current in the sheets and turned until the self-induction of the standard resistance is compensated for—that is, until the potential at the terminals *k* becomes equal to *ir*; this moment is fixed by comparison with an inductionless resistance.—Lond. *Engineering*, Dec. 17.

Reichsanstalt.—The conclusion of the long account of the work of the Reichsanstalt in 1908. In the present instalment especially electrical researches, thermometry and photometry are dealt with. Some results of special interest are, or will be, given elsewhere in the Digest.—Lond. *Engineering*, Dec. 17.

Telegraphy, Telephony and Signals.

Telephone Statistics.—H. von Hellrigl.—An article giving several interesting statistical tables on telephone statistics in

	Telephones in 1909.	Length of lines in km.	Number of telephone conversations per year.
United States	6,600,000	22,300,000	11,373,000,000
All other countries	2,900,000	11,800,000	5,633,000,000
Europe	2,500,000	10,400,000	5,013,000,000
American, except United States	300,000	800,000	138,000,000
Asia	100,000	300,000	313,000,000
Australia	70,000	300,000	158,000,000
Africa	7,000	10,000	11,000,000

the world. The statistics bring out chiefly the enormous advances which have been made in the use of the telephone in

the United States compared with that of all other countries. The chief figures are summarized in the foregoing table. Of the European countries Germany is first, with 880,000 telephones in 1909, England second with 590,000, and France third with 197,000.—*Elek. und Masch.* (Vienna), Dec. 12.

Electric Traction and Telegraphy.—E. MIRABELLI.—Considerable trouble has been experienced on single-conductor telegraph lines along the Valtellina Railroad, in northern Italy, operated by three-phase currents. Alternating currents of variable intensity were observed on the telegraph line and they were so strong as to disturb telegraphic transmission. No improvement was obtained by means of inductance coils or condensers. By installing a return circuit and insulating the telegraph line with great care the troubles were removed, but this was not found feasible on all the telegraph lines. More recently the investigation has been taken up again and it has been shown that electrostatic induction is practically negligible, and that the stray currents passing from the rails into the earth are not the chief cause of the trouble, but that the trouble is due to electromagnetic induction. It does not seem, however, that an effective remedy has so far been established.—*L'Industrie Elec.*, Dec. 10.

Measurements for Wireless Telegraphy.—J. A. FLEMING.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. The author describes apparatus for measuring "high-frequency resistance," a thermoelectric ammeter for large high-frequency currents, a condenser with paraffin-oil dielectrics, standards of inductance, and a photographic spark counter. In connection with this last mentioned a number of records are reproduced which reveal the processes actually taking place in the spark-gap of a radiotelegraphic transmitter. The measurement of wave-length and logarithmic decrement of the oscillations are also discussed; and, in conclusion, reference is made to the measurement of the over-all efficiency of a transmitter. —Lond. *Electrician*, Dec. 17.

Miscellaneous.

German Electrical Industries in 1908.—J. EINHART.—A statistical article reviewing the present status of the chief electrical manufacturing companies of Germany, with data on the dividends paid, on the import and export of electrical machinery, etc. Concerning the relation between workingmen and companies it is stated that the workingmen are asking for an eight-hour working day. At present only three German companies have a working day of eight hours, otherwise the main working day in Germany is 9.5 hours (really in general two shifts of men each of nine hours a day). The number of workingmen in the electrical industries in Germany was 100,000 in 1907.—*Elek. Kraft. u. Bahnen*, Dec. 4 and 14.

(British) Institution of Electrical Engineers.—In the discussion of the paper by Lepine and Stelling, giving a comparison of the German and English electrical industries, recently abstracted in the Digest, a determined attack was made on the Council's policy in confining the activities of the institution to the discussion of technical matters and refusing to allow the institution to take its proper place as the representative body of the electrical industry. Messrs. Garcke, Rutherford, Raworth, Swinton and Rich strongly supported the condemnation of the present apathy of the institution toward the commercial aspects of the industry (for instance, tariff questions), while Dr. Kapp, Mr. Mordey, and to a lesser degree, Prof. S. P. Thompson, took the opposite view. "There was no doubt that the general feeling of the meeting was with those who criticised the council."—Lond. *Elec. Eng'ing*, Dec. 16.

Price of Copper.—GLIER.—The conclusion of his statistical article on the fluctuations of the copper price in the last 40 years. On the basis of the statistics of four independent bureaus it is shown that while the price of copper had formerly a tendency to go down, this has been changed during the last 10 years of the nineteenth century. The price has now an upward tendency. Statistics and curves are given showing that the same general rule holds true for other metals and other stable articles, like coal, meat, cotton and wheat.—*Elek. Zeit.*, Dec. 16.

Electrical Laboratory.—G. ROESSLER.—The conclusion of his illustrated description of the equipment of the electrical laboratory of the Institute of Technology of Danzig, Germany.—*Elek. Zeit.*, Dec. 16.

German Electrical Industry.—L. J. LEPINE AND A. R. STELLING.—A paper read before the (Brit.) Inst. Elec. Eng. The authors enumerate the salient factors in the methods of cheap production which render the Germans such serious competitors in the world's markets. In this connection reference is made to (1) the capitalization of the trade; (2) internal organization; (3) external organization; (4) works and their systems (methods in manufacture); (5) general features and design of machinery, showing variations from English practice, and comparison of weights; (6) scientific experimental work in factories. In discussing the general features of design of machinery the authors claim that the English direct-current machine shows more modern principles of design and except for slow-speed

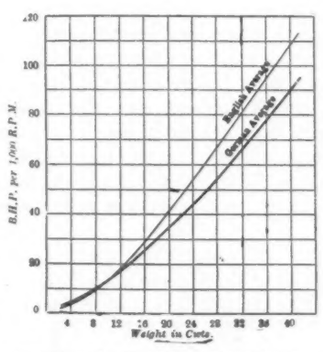


Fig. 5—Comparison of Weights, Direct-Current Machines.

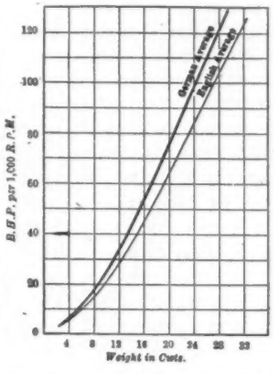


Fig. 6—Comparison of Weights, Induction Motors.

haulage motors, with which the Germans are very successful, England is in no way behind as regards design and workmanship. Fig. 5 shows a set of curves plotted for the purpose of comparison of English and German direct-current motors up to 100 hp with the horse-power per 1000 r.p.m. plotted against their weights. Two motors were all taken on a 440-volt rating. German firms formerly designed their machines with very large diameters and short length of core. This practice led to a high ratio of iron to copper in the armature, 2.7 ÷ 1 often being reached. New designs, however, now show from 1.8 ÷ 1 and 2 ÷ 1. Saturation of the teeth is carried as high as 24,000 lines per square centimeter on an average. As to induction motors, the authors say that they are more favorably impressed by the German design. Fig. 6 shows curves of weights against outputs of German and English induction motors. In summing up the position of the German electrical industry the authors emphasize first of all the commercial enterprise of the Germans, including good general management, close study given to any scheme or undertaking, and the judging of each one on its own merits; secondly, their large capital and the backing given them financially by the all-important banks. The large capital at their disposal assists them in their own country, and obtains for them good credit in foreign markets. Coming to the manufacturing side of the industry, the authors consider the two-shift system, together with cheap labor, and the thorough system of specializing, the most important factors in competition. "In design England is in no way behind; in fact, in several cases the English designers are more far-seeing and their designs more practical than those of their German competitors. If the English financiers and commercial leaders of the electrical industry were as enterprising and as successful as their German rivals, English manufacturers, supported as they are by the superiority of their productions, would have nothing whatever to fear from German competition in the open market."—Lond. *Electrician*, Dec. 10.

New Apparatus and Appliances

RELATION OF THE MANUFACTURER, JOBBER AND DEALER.

At the National Convention of Electrical Jobbers held at Hot Springs, Va., Dec. 7, Mr. G. R. Bliss, Jr., sales manager and treasurer of The O. C. White Company, Worcester, Mass., presented an interesting paper outlining certain methods employed by his company to insure the maintenance of fixed selling prices for its products, to make it possible not only for all jobbers, but also all contractors and dealers, to make a satisfactory profit on every sale, and, futhermore, to render it practically impossible to make a sale without such profit. After referring to the previous unsatisfactory condition with respect to these points, he stated that his company, which had for a number of years been doing a good local business with its line of adjustable electric light fixtures, and had decided to look after a wider field, concluded that the best method was to turn to the electrical jobber as a medium through which to dispose of its product. It was found, however, that there was a general lack of confidence among jobbers, who had found that some manufacturers would even cut their own prices in competition with jobbers who were trying to sell their goods. The problem to be faced was to furnish inducements to the trade to stock and push the line of goods, and this meant the elimination of price cutting.

The first step toward making the proposition attractive to jobbers was to divide the trade into three classes, as follows: Class 1—Consumers, including isolated plants, public institutions, governments, cities, towns, railroads and individuals. Class 2—The trade, including dealers, contractors, engineers and those purchasing for the purpose of resale. Class 3—Jobbers.

A minimum price was fixed for each of these classes. The minimum price of Class 1, or the consumer, was enough lower than list price to make large isolated plants satisfied that they received the consideration due them for purchasing in large quantities. The minimum price to Class 2, or the trade, was made enough lower than the minimum price to Class 1 to enable sales to be made to the latter at a fair and reasonable profit. This made contractors and dealers take an interest in and push the company's product. Mr. Bliss added that those who ignore the contractor, and are unwilling to protect him in his profits, make a great mistake. The minimum selling price to Class 3, or the jobber, was made enough lower than the minimum price to Class 2 to enable sales to be made to the latter at a fair and reasonable profit. It was, of course, realized that probably more than half the goods the jobber buys are resold, not to contractors, but to isolated plants or consumers, in which case he makes a double profit.

In practice it was found that the plan worked admirably. Customers of Class 2 were impressed with the importance of not cutting the price in selling to Class 1; probably two-thirds of the goods sold to contractors, either directly or through jobbers, are in fact resold at prices considerably higher than the minimum, and as yet there has not been a single complaint of price cutting against any one in Class 2. Some difficulty, however, was found in impressing on jobbers the importance of maintaining strictly the respective trade prices in selling to Class 1 and to Class 2. No difficulty was experienced in maintaining prices to the trade, but for some reason, difficult to explain, the jobber did not appear to want the double profit in selling to the consumer. In some cases where jobbers offered to deliver goods at cut prices their customers have sent their later orders direct to the manufacturer at regular prices, the reason probably being that a good buyer usually figures that if he is offered an article under price, without any good reason, he becomes shy of the man trying to give the impression that he sells goods to the customer cheaper than others can do.

In order to overcome the difficulties of jobbers cutting prices to Class 1, they were asked to sign a price agreement including a clause to the effect that if the agreement was violated, the right was reserved to refuse to sell them except at full list price. It was made plain that this clause would be enforced, and this has been done in the few cases of price cutting that developed. In some instances when the question arose the jobber went to his customer, explained matters, withdrew the original quotation, and finally secured the order at the right price. In other instances the violation of the clause resulted in the loss of the order to the jobber, and along with it, to a certain extent, the loss of his customer's confidence. In the latter case orders have finally come, either direct or through some other jobber or dealer, at the right price.

Mr. Bliss stated that, so far as he was aware, his firm had not lost even a single order through the enforcement of its price agreement; moreover, that many buyers for large isolated plants have expressed their unqualified approval of this policy, and have proved their sincerity by sending repeated orders without any question as to price, because they felt assured they would get the right price, which was all that they desired. Mr. Bliss added that in his opinion 95 per cent of the buyers throughout the country are entirely in accord with this method of doing business, and prefer to buy "one price" goods rather than to be obliged to shop around on every order they have to place, and in the end not feel quite certain that they have obtained the right price. The one thing necessary to secure maintenance of price is for the manufacturer to stand firm, and refuse goods to those who do not keep faith with him.

While it cannot be claimed that no one ever makes a sale at cut prices, on the other hand one is quite sure in the case of large bids to discover a cut price in time to hold back the goods necessary for filling the order, and as a small order usually is not shopped around for competitive bids, there is no reason in such cases for any one to cut the price.

In conclusion, Mr. Bliss stated that the experience of his firm during the past year demonstrates not only that it is possible to fix certain selling prices on merchandise and then enforce these prices, but that it pays the manufacturer to adopt this course, and also pays the jobber to impress upon his salesmen not to make mistakes, either inadvertently or otherwise, when giving quotations. After doing business strictly on this basis long enough to become accustomed to it, it will be found easier to maintain prices than to cut prices. It is doing business along the lines of least resistance for all to sell at the right price, each securing his share of the business and having every sale show a fair profit; and it is, moreover, the only way to keep the electrical jobbing business on a permanently safe and profitable basis.

ELECTRIC COW-MILKING MACHINE.

The milking machine manufactured by the Liberty Cow-Milker Company, of Hammond, Ind., and illustrated herewith, is made up essentially of two parts—the milk can or receptacle and the milking machine. The latter consists of a cover fitting tightly on the receptacle by means of a small rubber gasket. Mounted on the cover is a frame, a pair of vacuum pumps and a pair of double valves. The pumps are operated through a crankshaft by a 1/6-hp electric motor and connected to the crankshaft is a drive which puts double valves into motion. A needle valve beneath the vacuum gage is employed to regulate the vacuum to suit the needs of the cow being milked. The machine is 24 in. high and 7¾ in. wide. It weighs, with the motor, about 35 lb., and with the pail, which is 12 in. high, 17½ in. in diameter at the base and has an opening 7½ in. in diam-

ter, it weighs 50 lb. The total height of the milker over all is 36 in.

The pumps create a vacuum in the can, which is indicated by a gage. By means of the connection between the crankshaft and double valves, the latter will be in operation as soon as the crankshaft is in motion. The valve is so constructed that a hollow-cylinder connects the vacuum created in the can with the teat cup in one position, thereby drawing milk from the cow,

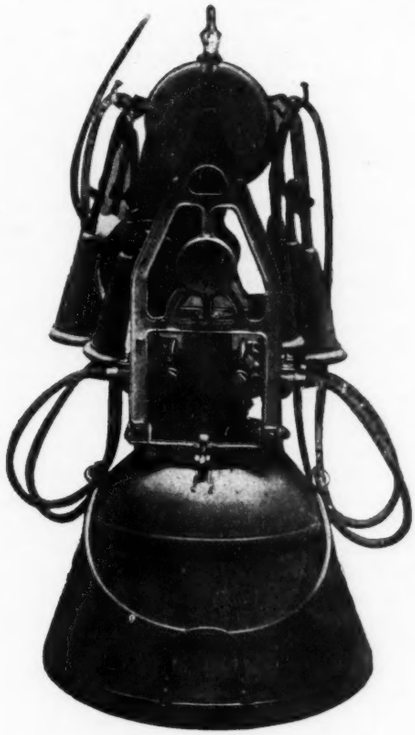


Fig. 1—Cow Milker.

and in the second position it breaks the vacuum and opens to the air, thus destroying the vacuum in the teat cup. After this operation is finished suction is again applied and milk drawn and the operation as above described repeated. Fastened on the udder of the cow is a pneumatic rubber cushion and an aluminum teat cup.

The milk upon leaving the teat by force of a vacuum

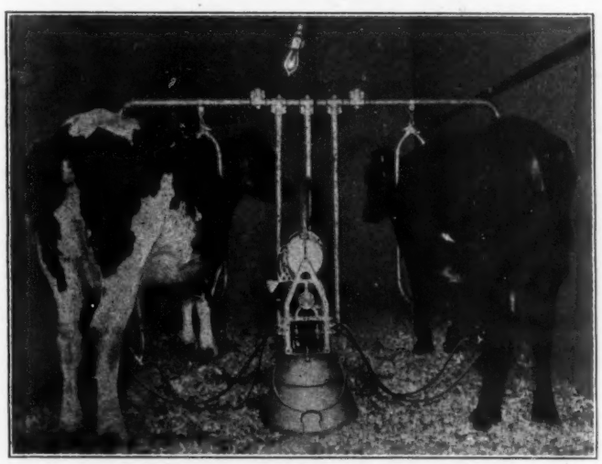


Fig. 2—Practical Application of Cow Milker.

is carried through a light rubber tube to the double valve, and from there is discharged into the milk pail under vacuum and having no contact with the air whatever. Beneath each teat cup is a small glass tube showing the flow of milk, and a small shut-off clip. This clip will collapse the tubing and thereby shut off the vacuum, so that when there is no milk flowing from the teat the clip can be closed and the teat cup taken off. A calf, as well as a hand-milker, milks the right and left section of the udder alternately, and a cow will give her milk down more freely if milked alternately than if the milk is drawn from all four teats at once, accordingly this machine is so constructed that when suction is applied to the two right teats, the two left teats are released. Milk is never drawn from all four teats at the same time. The milking device can be applied to two cows at once and a skilled man, under favorable conditions, is said to be able to control five machines, thereby milking 10 cows in almost the same time a hand-milker would require for milking one cow.

MOTOR-DRIVEN DOUGH MIXER.

The tedious labor of dough mixing, egg beating, etc., can not only be performed economically and quickly by the electric motor, but the work done considerably more thoroughly than by human labor. The superior sanitary advantages of the electrically driven apparatus are also important considerations in the preparation of a food stuff, as well as the fact that the mixture is assured to be uniformly and completely worked, without the constant attention of a skilled operative or baker.

A useful form of cake mixer and egg beater is shown in the accompanying illustration. This shows a ½-hp, Westinghouse, alternating-current motor driving a "Baby Grand" dough mixer, built by the Read Machinery Company, York, Pa. The little motor, which is of the two-phase, 60-cycle,

Motor-Driven Dough Mixer

CCL type, runs at 1740 r.p.m., driving the pulley on the mixer at 350 revolutions. Through the arrangement of a nest of gears, three speeds are obtainable at the mixer paddle.

The model shown has its pan equipped with a hot-water bath for making warm batches. In the size of machine shown two pans are provided, of 5-gal. and 10-gal. capacity respectively. Several different paddles are also furnished, each especially suited to some certain consistency of the mixture and the speed at which it is to be worked. The pan is raised and lowered by the handwheel and worm seen paralleling the standard.

Of special interest is the peculiar motion described by the mixing paddle which, by an arrangement of planetary gears, is kept rotating while it revolves about the center of the pan. The resulting "cutting" and mixing action is most similar to that of hand mixing, and produces a quality of batch which is nearest like that of the hand-mixed dough. The result is obtained, however, much more quickly and thoroughly than is possible in the old hand-kneading processes.

CHICAGO ELECTRIC AL SHOW.

The fifth annual Chicago Electrical Show, which will open on Saturday afternoon, Jan. 15, has an entirely new scheme of booth lighting this year. Each booth will be illuminated from the center of a four-cornered arch directly over the exhibitor's space, eliminating all aisle lighting. These arches will support colored-glass domes under which there will be clusters of tungstens, 40 watts, 60 watts and 100 watts. In this manner the exhibitor gets the entire benefit of the illumination, the great rows of colored domes creating an attractive and restful decoration. All of the decorations were created by D. H. Burnham & Company, architects, who have successfully handled this work in former Chicago Electrical Shows.

More exhibition space for the 1910 show has been sold than ever before, and the list of exhibitors, as a whole, is by far much more representative, covering, as it does, every branch of the electrical industry. The complete list to date is as follows:

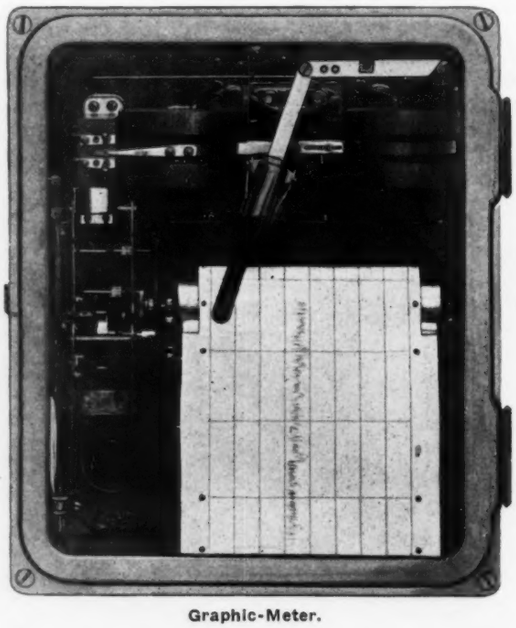
American Steel & Wire Co.	Chicago.
Crane Co	Chicago.
Electrical Record	New York.
Electrical World	New York.
Keller Mfg. Co.	Philadelphia.
Hinde & Dauch Paper Co.	Sandusky, Ohio.
Hoskins Mfg. Co.	Detroit, Mich.
Fort Wayne Electric Works	Fort Wayne, Ind.
The Acme Wire Co.	New Haven, Conn.
Electrical Testing Laboratories	New York.
Long Beach Elec. Mfg. Co.	Long Beach, Cal.
Schneible Co.	Buffalo, N. Y.
Wonderful Pump	New York.
Milwaukee Vacuum Mchy. Co.	Milwaukee, Wis.
Swedish-American Tel. Co.	Chicago.
Duntley Mfg. Co.	Chicago.
Pelouze Elec. Heater Co.	Chicago.
Electrical Review Pub. Co.	Chicago.
General Vehicle Co.	Long Island City, N. Y.
Federal Electric Co.	Chicago.
Driver-Harris Wire Co.	Harrison, N. J.
Hurley Machine Co.	Chicago.
Neville Ill'g Sign Co.	Chicago.
Electric Cleaner Co.	Chicago.
National Acme Mfg. Co.	Cleveland, O.
Simplex Elec. Heating Co.	Cambridge, Mass.
Grand Ledge Clay Product Co.	Chicago.
M. Klein & Sons	Chicago.
Vulcan Elec. Heating Co.	Chicago.
Popular Electricity	Chicago.
Illinois Appliance Co.	Chicago.
Oral & Motion Mfg. Co.	Chicago.
Chicago Pneumatic Tool Co.	Chicago.
Perfection Vacuum Cleaner Co.	Chicago.
Commonwealth Edison Co.	Chicago.
Westinghouse Elec. & Mfg. Co.	Pittsburg, Pa.
Chicago Fuse Wire & Mfg. Co.	Chicago.
Telephony Pub. Co.	Chicago.
Cutler-Hammer Mfg. Co.	Milwaukee
Hahl Automatic Clock Co.	Chicago.
G. L. Jackman	Chicago.
Henry Newgard & Co.	Chicago.
E Z Vacuum Cleaner Co.	Chicago.
Appleton Electric Co.	Chicago.
Electrical Age Co.	New York.
National Carbon Co.	Cleveland, Ohio.
Stoltz Electrophone Co.	Chicago.
Electro Magnetic Tool Co.	Chicago.
Kimble Electric Co.	Chicago.
Empire Vacuum Cleaner Co.	Winona, Minn.
Macbeth-Evans Co.	Pittsburg, Pa.
Cosmopolitan Electric Co.	Chicago.
General Electric Co.	Schenectady, N. Y.
Sefton Mfg. Co.	Chicago.
National Battery Co.	Chicago.
Electric Storage Battery Co.	Chicago.
Western Electric Co.	Chicago.
Chicago Telephone Co.	Chicago.
Pacific Electric Heating Co.	Ontario, Cal.
Stromberg-Carlson Telephone Co.	Rochester, N. Y.
National Electric Lamp Association	Cleveland, Ohio.
Allis-Chalmers Co.	Milwaukee.
American Ironing Machine Co.	Chicago.
Chas. L. Kiewert Co.	Milwaukee.
Fairbanks, Morse & Co.	Chicago.
Phoenix Glass Co.	Pittsburg, Pa.
Ralph Temple	Chicago.
Como Electric Co.	Spring Lake, N. J.
U. S. Light & Heating Co.	New York.
Manhattan Electric Co.	Chicago.
Electrocraft Pub. Co.	Detroit, Mich.
A. W. Kratz	
General Acoustic Co.	New York.
American Sign Co.	Kalamazoo, Mich.
G. M. Gest	New York.
Thompson Bros. Co.	Grinnell, Iowa.
Hoover Suction Sweeper Co.	New Berlin, O.
Bishop & Babcock Co.	New York.
Como Electrical Co.	Spring Lake, N. J.
Collins Wireless Telephone Co.	Newark, N. J.
Shelton Electric Co.	New York.
Walden W. Shaw Co.	
Enterprise Optical Mfg. Co.	
Stromberg Electric Mfg. Co.	
Electric Storage Battery Co.	Philadelphia.
C. G. Everson & Co.	Chicago.
North Shore Electric Co.	Chicago.
Consolidated Electric Appliance Co.	
Houston Mfg. Co.	
Excello Arc Lamp Co.	New York.
Chicago Telephone Co.	Chicago.
American Telephone & Telegraph Co.	New York.
Nohe Electric Renovator Co.	

GRAPHIC-METER ANALYSIS OF SUBSTATION LOAD.

An example of the value of the graphic recording meter for analyzing power loads was recently shown in a substation which supplies power to the terminal yards of a large railroad system. In this instance, as a result of the application of the meter it was found possible to reduce the capacity of the machines operating by more than half, thereby diminishing operating expenses and improving the efficiency and load factor of the remaining generating equipment.

The substation referred to contains one 37½-kw and two 25-kw motor-generator sets, which supply direct current at 250 volts to three turntables and one small crane. Each of the turntables is driven by a 22-hp series motor with rheostat controller, and is capable of turning a locomotive 180 deg., or end for end, in one minute. The crane is about 5 tons capacity and subject to very intermittent service, so that its operation has little effect on the total station load.

The turntables are held ready for service at all times. Rush-hour periods occur in the morning and evening, and at these times the tables are usually very busy. A locomotive to be turned goes to the nearest unoccupied table, and in this way it



Graphic-Meter.

is rarely the case that two turntables are started at once, although two or three may be in operation at the same time.

Before the study of the actual load conditions had been begun it was customary to operate all three motor-generator sets during the rush hours. At these times the violent oscillation of the needles of indicating meters on the generating panels, striking against the stops, seemed to indicate that more generating capacity was needed. In order to determine this latter question

definitely, a Westinghouse graphic recording meter was obtained and inserted in the main feeder. The tests covered a week's careful study, during which time the load on the station was continuously recorded. That section of the curve reproduced herewith was secured during one of the rush periods. To obtain a clear record, a paper speed of 24 in. per hour was used.

The record shows that the average peak encountered during the starting of a turntable is 120 amp. This drops to a value of from 50 amp to 70 amp during operation, after the table has been accelerated. The maximum peak noted was about 180 amp at the time of starting two turntables simultaneously.

As the full-load current of the 37½-kw motor-generator set alone is 150 amp, it becomes very clear that the existing station capacity is ample to handle the present service besides a large future increase. Since the tests it has been found necessary to operate only the one largest unit, and the former practice of running all three sets has accordingly been discontinued. The result is improved operating economy, efficiency and load factor.

This example thus cites an instance where, in spite of a suspected insufficient station capacity, it was demonstrated that less than half the equipment already installed was needed for the existing demand. The graphic indicating meter is equally impartial in showing up overloaded apparatus, and often performs valuable service in indicating unsuspected load conditions which give rise to excessive heating and impaired regulation and efficiency, the cause of which cannot otherwise be traced.

The important results obtained from graphic meter analysis of motor-driven machines and apparatus have been repeatedly shown. Loss of time has been eliminated, and the productiveness of both machine and operator largely increased, as a result of the definite location of "low spots" in the motor load curve.

Experience has proved that in almost every power operation there may be considerable unknown and unnecessary losses, which may be promptly localized by analyzing the graphic meter curve and remedied, with resultant increased production or decreased operating expense.

ELECTRICAL DRIVE IN MEAT-PACKING PLANTS.

In no industry are the advantages of individual motor drive more marked than in the packing house. While excessive losses attend a system of mechanical power transmission in any application, the presence of steam and moisture in a meat-packing house aggravates its inherent weakness to such an extent that both the production and efficiency in an installation of this nature are reduced much below similar systems in other industries. Again, in order to maintain the immaculate degree of cleanliness so necessary in the dressing of meats, the absence of shafts, pulleys and belts is indeed desirable.

Among the recent packing plants to adopt electric drive is that of the Fried & Reineman Company, North Side, Pittsburgh, Pa. In 1907 this company contemplated the enlargement of its plant and the proposition of electric motors was then first considered. Carefully conducted tests were made of the old system and the final records indicated that approximately 60 per cent of the power delivered at the engine crank was absorbed in the elaborate system of shafting and belts necessary to transmit the power throughout the plant. The plant has outgrown the size which could be served by the present engine and boiler equipment with any degree of efficiency, and the problem resolved itself into choosing a system which would prove most economical as well as efficient.

If mechanical drive was to be retained it would be necessary to divide it into at least two sections and put in a second engine at a point common to the second section of shafting. With this a central boiler plant might be maintained, but the losses by condensation in the steam piping to the farthest engines would, of course, have been excessive. On the other hand, the maintenance of separate boiler plants would be accompanied by considerable extra expense. With these conditions to meet, electricity obviously presented itself as the most logical means of accomplishing the end in view, and it was, therefore, decided to adopt the "unit-drive system." Having decided on the method of drive, a "test" motor was procured and the various machines were worked under different conditions of load to determine the size and types of motors best adapted for their operation. Belts were entirely eliminated and with but one or two exceptions it was decided to equip each machine with an individual motor.

All motors specified were totally enclosed to protect the

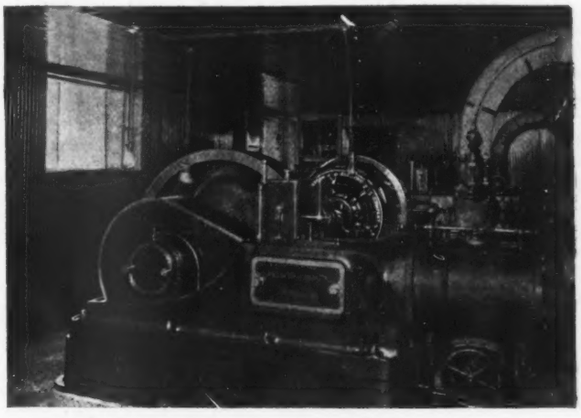


Fig. 1—Engine Room.

windings from water and moisture which had been a constant source of trouble with the old system of belts. Where the speed of the machines was such as not to adapt them for direct drive, as for instance, in the "silent cutters," illustrated in Fig. 2. Morse silent chains were used. It will be noted by referring to the photograph that for the "silent cutters" the commutator end of the motor shaft is extended and fitted with a sprocket to equalize the pull on the shaft to which the cutter is directly attached.

The general arrangement of the dynamo and engine-room is shown by Fig. 1. The equipment consists of two 75-kw, 225-250-volt, direct-current Hawthorn generators which are direct-

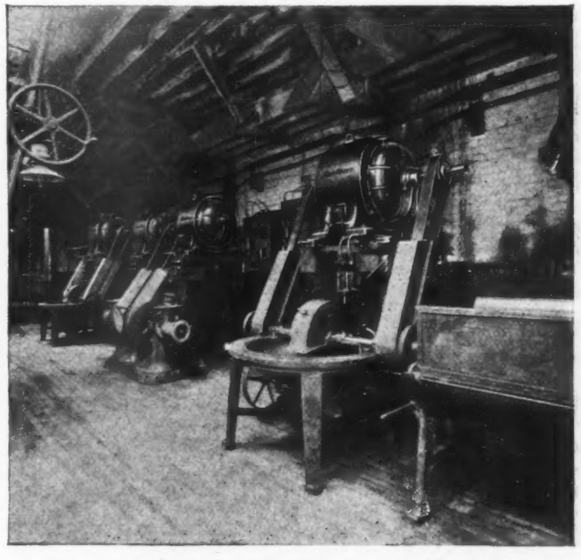


Fig. 2—Motors Driving Sausage and Meat Grinders.

connected to two 125-hp, 180-r.m.p., self-oiling, side-crank Ball engines operating on 100-lb. steam pressure. Provision has been made for increase in the capacity of the power plant equipment by the addition of similar units as occasion may demand. The switchboard, also shown in Fig. 2, is made up of two generator and two feeder panels of white Italian marble. The complete electrical equipment, comprising motors and generators, was furnished by the Western Electric Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There was the usual lull in retail trade last week that is to be expected immediately after the holiday rush. More complete returns from the country indicate that the volume of the holiday trade was eminently satisfactory, being far in excess of 1908 and fully as good as that of 1906, which was the best year in the history of the country. The liberality of the Christmas purchases indicates that the people generally are feeling reasonably prosperous. The heavy storm which has prevailed over almost the entire country has done much to check retail business, and has seriously interfered with the movement of merchandise. Continued delay is experienced in the Northwest on account of the strike of the switchmen, but as this trouble remains local in its character it is creating no general uneasiness. Among the wholesalers and jobbers there is as much business as is expected at this time of the year. The high price of cotton is causing both the producers and the purchasers of manufactured goods to proceed with caution. No one is anxious to stock up with cotton goods at the present prices beyond the immediate demand. In industrial lines generally the great activity of the fall continues. Practically all of the iron and steel mills are working overtime, and orders are piling up for delivery late in the spring, and in some instances for delivery up to the middle of the summer. The threatening attitude of the employees of the United Steel Corporation is causing some uneasiness, but it is hardly believed possible that in a time of such prosperity that differences between employers and workmen will be allowed to reach the point of an actual strike. The abnormally high price of all the necessaries of life is causing a general feeling of unrest among wage earners, and this will undoubtedly lead to demands for increased compensation before the end of the coming year. Collections are seasonably slow. Business failures for the week ended Dec. 30 as reported by Bradstreet's were 257, compared with 264 the previous week, 299 in 1908, 185 in 1907, 220 in 1906 and 278 in 1905.

THE COPPER MARKET.

During the last week of the old year the speculative interest in copper was renewed to some extent. Exporters bought liberally, and there was some revival in the purchases of domestic consumers. This temporary revival was probably in anticipation of a better statistical position at the end of December than at the end of the previous month. The result of the activity was an advance of about ¼ cent in standard copper in the local market. The majority of the sales made to domestic consumers were for February and March. The Amalgamated interests led in the advance movement, and the independents quickly followed. The yearly reviews of the market issued by copper authorities indicate that the year has not been a prosperous one for the industry. The output for the year was the most tremendous ever known, the domestic refineries turning out 1,407,000,000 lb., and the world's output amounting to 1,915,200,000 lb. Domestic deliveries have amounted to about 700,000,000 lb. and exports to 686,400,000 lb. The refinery stocks on hand at the beginning of the year, according to the government figures, approximate 143,000,000, an increase of about 22,000,000 over the figures of the year previous. Such figures as these have made it hard for even such a virile force as the Amalgamated interests to keep prices from sagging. Their success in their efforts has been the wonder of the market. The exports for December were 28,104 tons. The daily call on the Metal Exchange Jan. 3 quoted standard copper as follows:

	Bid.	Asked.	Selling price.
Spot	13.37½	13.62½	.....
January	13.37½	13.62½	13.50
February	13.40	13.70	13.55
March	13.40	13.70	13.55
April	13.40	13.70	13.55

The London prices Jan. 3 were as follows:

	Noon.	Close.
Standard copper, spot	£62 0 0	£61 13 9
Standard copper, futures	62 18 9	62 13 9
Market	Firm	Easy
Sales of spot		580 tons
Sales of futures		1000 tons

Extreme fluctuations for last year:

	Highest.	Lowest.
Standard	13.45c	12.12½c
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

BUSINESS OF INDUSTRIAL COMPANIES.

General Electric Business.—The business of the General Electric Company for 1909 has averaged about $5,000,000 per month. The total business for the 11 months since the beginning of the company's fiscal year, Feb. 1, will be approximately $55,000,000. On account of the new incorporation tax law, the General Electric Company has changed its fiscal year to end Dec. 31, instead of Jan. 31, as heretofore. Speaking of the company's business, A. W. Burchard, assistant to the president, made these statements: He said that the business of the company would show a larger percentage of profits than in 1908, owing to the fact that during that year the company had done some housecleaning in the way of charging off for depreciation, maintenance, etc. This would make the next report of the company show better profits than the last one. He said also that a large percentage of businesss had been done in small apparatus, and that this class of goods brought in more profit than heavy machinery and involved less engineering risks. Quite a number of additions to the plants have been completed during 1909, these in the main following out the development plans that were made in 1907. The present capacity of the company has probably increased 10 or 15 per cent over the capacity of two years ago. Prices, however, for material are not as high as they were in 1907, and on this account the same volume of business does not represent as large an amount of money. It is estimated that at the present prices the company is capable of turning out in the neighborhood of $6,000,000 per month in finished product. The prospects for the coming year are regarded by the officials of the company as exceedingly bright.

Allis-Chalmers Company.—The Allis-Chalmers Company reports that the orders booked for the six months which ended Dec. 31, 1909, were 70 per cent better than the orders for the same period in 1908, and that they were 25 per cent better than the orders that were booked in the same six months of 1907. Speaking of the business of the company, W. W. Nichols, third vice-president and secretary, said that the output during the year, month by month, was constantly increasing, and that at the end of the year it was up to fully 80 per cent of the capacity of the plant. During the times of extreme depression the plants were not operated to exceed 50 per cent of their capacity. The present capacity of the Allis-Chalmers Company is about $30,000,000 per year. This is about 75 per cent more than the total business that was done in 1908. Speaking of the character of the orders that had been received, Mr. Nichols said that there had been heavy business in mining machinery, both in this country and abroad, and there has been some electrical machinery sold in connection with these outfits. Taken as a whole, the electrical machinery ran rather to lighter apparatus than to heavy installations. He said, however, that his company was in the unique position of being able to furnish an entire equipment for every sort of plant. He said that it was the only company which could furnish either a steam, gas, steam turbine or hydroelectric equipment in connection with electrical power. The prospects for the ensuing year were thought to be exceedingly bright. The books are very well filled with orders, and inquiries and specifications indicated that much new business was being developed.

Western Electric Company.—According to an estimate made by a high official of the Western Electric Company, the gross business done by that company during 1909 will approximate $46,000,000. This compares with $33,000,000 done in the calendar year of 1908, $53,000,000 in 1907, $69,000,000 in 1906, and $44,000,000 in 1905. It will be seen that the company's business last year has only been exceeded twice in its history. According to this official, a large portion of the past year's business has been done in telephone apparatus and accessories connected with the telephone business. Sales have been large both to the Bell and the independent companies, an especial in-

crease being noted in the business done with the independents. There has, however, been a large business done in electric light supplies and in machinery for lighting. This branch of the business of the Western Electric Company is larger than ever before. While there have been some good orders taken for heavy machinery, a large portion of the business has been for small apparatus. The officials of the company anticipate a further increase in the business for 1910, and many of them believe that the best record of the company will be exceeded.

Westinghouse Business Vastly Improved.—One of the Company is responsible for the statement that the 1909 business of that company has been much better than for any recent years, and almost up to the banner year of the company's history. He says that at the present time the business is running about $2,500,000 per month, and that the total business for the year will be at least 85 per cent of the best business ever done. Quite a large proportion of this year's business has been done in small machinery, and, according to this official, this is due to the fact that few large contracts have been let. He said that very little great development was going on now, there was no railroad electrification of any considerable size and no big power plants, either hydroelectric or steam, were being constructed. The order from the Pennsylvania Railroad for locomotives was the only really large order that has appeared during the year. This official expects that the next year will bring out a considerable number of large orders, as he is informed that plans for financing several big development projects are practically matured.

Telegraph Companies Have Had Good Year.—The Western Union Telegraph Company shows through its quarterly reports that its earnings during 1909 were constantly increasing. The officials of the company report that the business at the present time is entirely satisfactory, and that it is believed that the alliance with the American Telephone & Telegraph Company will vastly increase the business in 1910. The various telegraph systems which are held by the Mackay Companies also appear to have increased their business during the past year. Not only this, but there is evidence that the system is branching out, and will make bids for new territory. Clarence H. Mackay, president of the Mackay Companies, has recently returned from a trip to the Northwest, during which, it is understood, he made arrangements for securing a portion of the business in that section. An especial increase was made in the business done by the cable companies of this concern. While it is denied explicitly that there is any merger contemplated between the two great telegraph companies, it is well understood that they will be operated harmoniously.

Crocker-Wheeler Company.—Speaking of the year's business, Rodman Gilder, secretary of the Crocker-Wheeler Company, of Ampere, N. J., said: "During the year 1909 our company did about 35 per cent more business than in 1908 in induction motors, direct-current motors, alternating-current motors, direct-current generators, transformers, etc. The outlook for 1910 is very encouraging, and in fact the company has orders already in hand which indicate a very great increase of business during the next twelve months. In the period of depression the company rigidly adhered to its policy of keeping up its facilities, both personal and physical. At the present time it is in a position to take care of the volume of business already coming in, and has a personnel of designing engineers and sales engineers upon which it can depend for results. It is still as it has been since its foundation in 1888, a company of engineers as well as manufacturers. This is indicated by the phrase used for many years in describing the company: 'Manufacturers and Electrical Engineers.'"

Cotton Mills in the South.—It is stated that the construction work during the past year on cotton mills in the South has amounted to $26,000,000. This sum covers not only new construction, but the addition to the equipment of mills already in service. North Carolina leads the list of states in the number of new mills built. The fact that there has been such an extensive development in this industry in the South during a year which has not been favorable, on account of market conditions, to the manufacture of textiles, is taken to indicate that the development in the future will be much greater. It is estimated that if there should be a large cotton crop next season, the amount of money expended in new mills throughout the South in 1910 would double the amount spent during the past year. Practically all new mills are electrically equipped.

Niagara Falls, Welland & Dunnville Railway.—The following are the directors of the Niagara Falls, Welland & Dunnville Electric Railway Company, which is applying to the legislature for a charter: J. Cralton Gardiner, engineer, of Niagara Falls; William Maxwell, Welland; Geo. H. Burgar, Welland; F. S. Buell, Buffalo; F. R. Lalor, M. P., Dunnville; George Arnold, Ridgeville. The route will be from Niagara Falls to Allanburg, along the east side of the Welland Canal to Port Robinson, then west by the Forks Road to Dunnville. Branches will also be built to other points, and it is expected that the whole system when completed will embrace 50 miles. The company is capitalized at $1,000,000, and Hugh A. Rose, of Welland, is solicitor.

Rumored Merger of Canadian Electrical Manufacturing Concerns.—It is rumored that the leading electrical manufacturing companies of Canada are making overtures for an amalgamation. Recent competition among these companies in which tenders were given is thought to have lost money to the concern that obtained the contract, and has evolved the idea that the combination of the electrical interests would be beneficial to these companies. It is rumored that there is already an effort under way to assimilate the large electrical companies into one concern and void future cutting in prices. Paul J. Myler, General Manager of the Canadian Westinghouse Company at Hamilton, when interviewed, declared that such an amalgamation had never been considered.

Telephone Train Dispatching in Texas.—The Gulf, Texas & Western Railroad Company is installing the telephone for train dispatching on its line between Jacksboro and Benjamin, Texas. This is a new road, located to the northwest of Fort Worth and joining the Chicago, Rock Island & Gulf and the Wichita Valley Railroads at Jacksboro and Seymour. The line is 105 miles long and has adopted the telephone method of handling its trains. The apparatus was purchased from the Western Electric Company. The line is constructed of No. 12 B. & S. gage hard drawn copper. The example of this road is one being followed now by many short lines under construction.

Texas Electric Railway Project.—Announcement has been made by C. L. Hoges, of Chicago, and L. L. McSweeney, of New York, that they are in charge of the preliminary work of a projected electric railroad to connect the principal cities of Texas. It is given out that behind this project is a syndicate representing $26,000,000 of capital. The company plans to construct 1,000 miles of roadway within the next three years. Surveys have already been made for lines connecting Fort Worth and San Antonio, 250 miles; San Antonio and Houston, 270 miles, and Houston and Dallas, 275 miles. It is said that upon the first named of these lines construction will begin within 90 days.

Fremont (Neb.) Gas & Electric Light Company.—Henry L. Doherty & Company, of New York, have taken over the management of the Fremont, Neb., Gas & Electric Light Company. At a recent meeting of the stockholders the following officers were elected: Henry L. Doherty, president; R. M. McGinnis, vice president; Henry Warner, secretary and treasurer; W. B. Stark, assistant secretary and manager. It has been determined that $25,000 will be expended in 1910 on betterments of the property, and thereafter as much will be spent annually as is necessary to give the patrons first class service.

To Advertise the Mazda Lamp.—The General Electric Company is preparing an extensive general advertising campaign in connection with the bringing out of the new Mazda lamp. On account of the adoption of this name for a general type of lamp it is thought that widespread advertising will do a great deal of good. The virtues of the metallic filament lamp will be set forth in all parts of the country.

Colorado Railway, Light & Power Company.—The newly incorporated Colorado Railway Light & Power Company, which has taken over the properties of the Southern Colorado Power Company of Trinidad, as referred to in the issue of Dec. 30, will increase the capacity of the plants, it is said, from 1500 hp to 15,000 hp. The old company operated the traction and light services in Trinidad.

Exchange of Presents Between Employees.—J. H. Ainsworth, general manager of the Dayton Home Telephone Company, Dayton, O., was courageous enough, before Christmas, to issue a letter to the employees expressing his conviction that the exchange of presents between employees, and between the heads of departments and employees, or between the heads of departments, is inadvisable, and giving utterance to the hope that the practice will not be indulged in. Mr. Ainsworth said that he had no desire to detract from the good cheer of the holiday season, but that an experience of some years with operating companies led him to believe that the custom is unwise and may easily become burdensome.

Electrical Construction.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Manchester, Conn.; West Boylston, Mass.; Hutchinson, Kan.; Louisville, Ky.; Salt Lake City, Utah; Sheyboygan, Wis.; Waterloo, Ont., Can.; Johnsburg, N. Y.; Pendleton, Ind.; Murfreesboro, Ark.; Charleston, Mo.; Moorefield, W. Va.; Niles, Ohio; Boulder, Col.; Cincinnati, Ohio; Plattsburgh, N. Y.; La Crosse, Wis.; Grand Rapids, Wis.; Van Horn, Tex.; Fort Bayard, N. M.; Fremont, Neb.; Cozad, Neb.. and Amsterdam, N. Y.

Heavy Holiday Trade in Electrical Specialties.—An unusually heavy holiday trade in the various electrical appliances adapted for popular consumption is reported from the various cities where special efforts were made to secure this class of business. In Chicago the Electric Shop of the Commonwealth Edison Company figured conspicuously in Christmas shopping, and customers have purchased a large number of portable lamps and various small household appliances. The demand for heating appliances was particularly heavy, and the number of toys and novelties sold was also very large.

New Canadian Railway Project.—A new electric railway company is being organized in Toronto to build and operate a line running northward from Toronto to Barrie, with branches to Orillia and Owen Sound via Meaford. Application will be made for a charter at the next session of the Ontario legislature by W. H. Price on behalf of the promoters. Mr. Price stated that he was not yet at liberty to give out the names of the men behind the scheme, but he stated that construction work would begin next spring if the charter is secured this session.

American Blower Company's Christmas Gift to Employees.—In accordance with a custom established three years ago, the American Blower Company, of Detroit, presented the day before Christmas to each employee a sum in crisp new one-dollar bills equal to the years of continuous service with the company. Enclosed with the bills in an envelope decorated in holiday colors was a handsome booklet containing a short historical sketch of the company and portraits of the officers and four of the oldest employees.

Davenport (Ia.) Water Power Company.—The Davenport Water Power Company has been organized and has been granted a franchise for the purpose of developing the Davenport-Leclaire rapids in the Mississippi River. A concrete dam will be constructed costing between $2,000,000 and $4,000,000. It is expected to develop 16,000 hp.

Chicago Railways Earnings.—The earnings of the Chicago Railways Company for December showed a gross of approximately $1,050,000, an increase of 12 per cent over December 1, 1908. On the day before Christmas the gross receipts were $41,000, or 820,000 fare passengers.

Catalogs Wanted.—Otto P. Diedrich, who has purchased the electrical contracting business of John L. Madison at Southington, Conn., writes that he would like to receive catalogs from makers of electrical appliances and supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street has been marked by increased activity in stocks, with more or less irregularity as to prices. Immediately preceding the New Year's holiday, the tone of the market was good and without the interference of outside influences moderate advances would have resulted. The Street, however, had not recovered from the sensational flurry in Rock Island which occurred the opening day of the week. This not only created indignation among the regular traders but it had the effect of intimidating many an outside investor and speculator. Pointed evidence of such flagrant manipulation is not reassuring to the uninitiated. The result has been that few outsiders have been in the market. On Jan. 3 the first business day of the new year, the market was active and weak. Railroad securities were especially disturbed by reports from Washington that the President could not be shaken from his position in favor of a Commerce Court and Federal control of railroad capitalization. Such a broadening of the scope of the Interstate Commerce Commission would mean serious interference with the financing plans of many companies, and probably serious interference with the transaction of their traffic business. Another feature which was disturbing to trading was the advance of call money to 14 per cent. While this is not unusual at this period of the year and was more or less anticipated in view of the fact that the distribution of dividends between Jan. 1 and 15 amounts to $240,000,000, the fact that the rates of time money were not affected indicates that the money market is in no serious trouble, but the high rate for call loans necessarily caused considerable liquidation and checked speculation. Under these influences almost the entire list declined, and the more active issues were under rather heavy selling pressure. The condition is regarded as purely temporary. On Jan. 3 call money was quoted 6 @ 14 per cent, the last loan at 12; 90 days, 4½ per cent. The quotations in the table are those of the close, Jan. 3.

NEW YORK.

	Dec. 27.	Jan. 3.	Shares sold.		Dec. 27.	Jan. 3.	Shares sold.
All-Ch.	15*	15	650	Int.-Met., pfd.	62	60¾	29,500
All.-Ch., pfd..	54¼	54½	1,400	Mackay Cos..	91½	91	600
Amal. Cop...	87¾	90⅜	161,350	Mackay C.,prf.	77½	77½	500
Am. D. T....	20½	20½*	——	Man. Elev...	138¼	138	200
Am. Loc.....	59¼	61½	5,200	Met. St. Ry..	23*	23*	100
Am. Loc. pfd.	116	115	600	N.Y.&N.J.Tel.	139¼	139¼	——
Am. Tel. & C.	77½	77½*	——	Steel, com...	90⅞	89⅛	382,350
Am. T. & T..	142½	140⅝	11,796	Steel, pref...	125⅛	124¾	6,760
B. R. T.....	79½	79¼	13,055	W. U. T.....	76⅝*	76⅝	2,650
Gen. Elec....	159½	159⅜	1,625	West'h., com.	81¼	81¾	3,200
Int.-Met.,com.	24⅞	24	33,600	West'h., pfd..	133*	130*	20

PHILADELPHIA.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Am. Rys.....	47	48	Phila. Elec.....	13⅞	14
Elec. Co. of A.....	12⅜*	12¼*	Phila. R. T.....	26⅞	28⅛
Elec. St. B'ty.....	60	61	Phila. Trac.....	88½*	88¾
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52	52¼

CHICAGO.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	137*	137
Chi. Rs., Ser. 1.....	109	109	Met. El., com.....	17¾	17¾*
Chi. Rs., Ser. 2.....	32	35	Met. El., pfd.....	55½*	55½*
Com. Edison.....	118½	120	Nat'l Carbon.....	100	108½
Chi. Subways.....	4¾*	4¾*	Nat'l Car., pfd.....	122½*	122½*

BOSTON.

	Dec. 27.	Jan. 3.		Dec. 27.	Jan. 3.
Am. T. & T.....	142½	140¾	Mex. Tel.....	2¾	2¾
Cum. Tel.....	145⅜*	144	Mex. Tel., pfd.....	5½*	6*
Edison E. Ill.....	250½	251¾	N. E. Tel.....	138	137½
Gen. Elec.....	159*	159¼	W. T. & T.....	17*	16½
Mass. E. Ry.....	16½	18½	W. T. & T., pfd.....	93	94
Mass. E. R., pfd....	78½	80¾			

* Last price quoted.
Shares sold are for week of Dec. 27 to Dec. 31.

Deschutes Irrigation & Power Company.—It is announced that the first mortgage bond-holders' committee of the Deschutes Irrigation and Power Company, of which F. R. Schinn, Columbus, O., is chairman, has come to an agreement with the company in regard to the refunding of the bonds, the interest on which has been in default for more than a year. The bonds and the overdue coupons will be refunded by a new first mortgage 6 per cent bond, the issue, sufficient to accomplish this purpose, being dated Jan. 1, 1910, and due in seven years. The collateral trust bonds, $109,000, maturing March 1, 1910, will be extended for five years, with the other unsecured claims. A new board of directors will be elected. This company is building an extensive irrigation system on the Deschutes River, in Oregon. The company has made a contract with the State for the reclamation of 215,000 acres of desert land. The headquarters of the company is at Bend, Cook County, Ore. The company will receive a liberal portion of the price at which the State sells the land that is reclaimed.

North Shore Electric Company, Chicago.—The report of the North Shore Electric Company, of Evanston, Ill., for the fiscal year which ended Sept. 30 shows that the earnings were larger than for any similar period in the company's history. For the first time since the organization of the company the gross revenues were more than $1,000,000. The gain over the previous year was almost $200,000. After paying the regular 3 per cent dividend, the company added $35,000 to its surplus account. The report of the president, Samuel Insull, says that manufacturing industries are becoming more and more educated to the use of electric power and that the industrial business of the company has largely increased.

Chicago's Railway Merger.—Official announcement has been made of the plan upon which the Chicago City & Connecting Railways Company expects to take over the transportation lines in the southern division of that city. The announcement was made by Ira M. Cobe, who has been one of the leaders in promoting the consolidation. The official statement says that the property as a whole is to be taken over on a 4 per cent basis—that is, after payment of interest upon rehabilitation bonds and the city's percentage of earnings, the net earnings for 1910 upon the bonds and shares of stock deposited will be approximately $2,550,000, which is 4 per cent upon $62,000,000. This capitalization will consist of $22,000,000 5 per cent first lien bonds, which are the only securities that will be offered to the public at this time. Instead of issuing the $25,000,000 preferred and $15,000,000 common stock at first proposed, there will be issued participation certificates, which, while without any face value, will be entitled to certain percentages of the earnings over and above the fixed charges. The plan for the issuance of these certificates is only partially matured, but it is practically agreed that they will be two classes, and the division of earnings will be 4½ per cent for the first class, after which the second class will receive 4 per cent. After this the two classes divide the earnings up to 6 per cent, which is the limit allowed for the first class. It is presumed, but not so stated, that the division of these certificates will be in the same proportion as the first plan proposed to divide the stock issue between preferred and common. The bonds will be dated Jan. 1, 1910, and will mature Jan. 1, 1927. They will be secured by deposit with trustees of the following securities: $16,971,900 City Railway stock, valued at 200; $5,000,000 Calumet & South Chicago bonds, $1,635,000 Southern Street Railway 5 per cent bonds, $800,000 Southern Street Railway stock, $1,000,000 Hammond, East Chicago & Whiting first mortgage 5 per cent bonds, not yet issued, and $1,000,000 of the same company's common stock, not yet issued. The securities comprise all the bonds and stocks of the Southern Street Railway and of the Hammond, East Chicago & Whiting. The provision of deposit will include caring for the debts of the underlying properties, other than those incurred for completion and rehabilitation. A sinking fund is provided after the third year which will result in the retirement of $3,000,000 of the bonds before maturity. The earnings of the combined properties are about 2 1/3 times the interest requirements of the bonds. It is stated that the bonds are underwritten and partly sold. The unsold portion will be offered in New York and Chicago by J. P. Morgan & Company, the Illinois Trust Company and the First Trust & Savings Bank.

Utility Merger in Michigan.—An official announcement has been sent out by E. W. Clark & Company, of Philadelphia, giving the details of the proposed merger of public utilities in Michigan, which was referred to in our last issue. The new company is to be called the Commonwealth Power, Railway & Light Company. There will be no issue of bonds of this company, but there will be issued $6,000,000 of preferred stock and $12,000,000 of common stock. The company is a consolidation of the water powers, electric light properties, electric railways and gas properties in various communities in the state of Michigan. The water powers involved, developed and undeveloped, are those on the Muskegon, Kalamazoo, Grand and Au Sable Rivers. The companies to be taken over are the Commonwealth Power Company, of Jackson, Mich.; Grand Rapids-Muskegon Power Company, Saginaw-Bay City Railway & Light Company, Grand Rapids Railway Company, Michigan Light Company, Flint Electric Company, Flint Gas Company, Cadillac Water & Light Company, Charlotte Electric Company, Shiwassee Light & Power Company and the Au Sable River property and rights. The announcement says that the rivers mentioned are now developed to the extent of 25,000 hp, and are capable of furnishing large additional quantities of power, which it is proposed to develop from time to time to meet the growing requirements of the communities served. The plans for the consolidation provide that $1,150,000 in cash shall be placed in the treasury of the Commonwealth Power, Railway & Light Company for working capital, new construction and other requirements. The work on the Au Sable River plant is already well advanced, and the first development is expected to furnish 12,000 hp. A high tension transmission line is being built to Jackson which will be more than 200 miles long.

Public Service Corporation.—The directors of the Public Service Corporation of New Jersey have declared a second quarterly dividend of 1¼ per cent. At the meeting of the board, Dec. 28, the additional offices of third and fourth vice-presidents to the Public Service Corporation, Public Service Railway Company and Public Service Gas Company were created, and Randal Morgan, of Philadelphia, was elected third vice-president and Col. Anthony R. Kuser was elected fourth vice-president of each of the companies. Both have been directors of the corporation since its organization. Thomas N. McCarter, president of the corporation, has issued a notice to the motormen and conductors that, beginning Jan. 1, there will be an increase of wages upon a sliding scale. He also stated that the company had under consideration a pension plan for the benefit of its employees.

Southern Public Service Corporation of New Jersey.—A receiver was appointed at Camden, N. J., Dec. 28, for the Southern Public Service Corporation, organized under the laws of New Jersey. This corporation has a capitalization of $1,500,000, and the action under which the receiver was appointed was brought by the engineering firm of Ludwig & Company to settle a claim of $878. The corporation is chartered to build railroads and power plants in South Carolina and Georgia. It already owns all of the capital stock of the following South Carolina properties: Marion Water, Light & Power Company, Darlington Light & Water Company, Rock Hill Water, Light & Power Company, Florence Light & Power Company and the Timmonsville Water, Light & Power Company. James W. Calloway, of Atlantic City, has been appointed receiver.

New York Telephone Merger Completed.—The agreement completing the merger of the New York & New Jersey Telephone Company with the New York Telephone Company was filed last week with the secretary of state of New Jersey. The stockholders of the former company receive $142 per share for their holdings and the company practically is dissolved. All the property, franchises and contracts of the former company becomes property of the New York Telephone Company, and will be so operated. There was outstanding $30,021,700 stock in the New York & New Jersey Telephone Company, and this was all expected to be turned in before the end of the year just closed.

Great Eastern Telephone Company.—At the regular auction of securities in New York last week 25 shares of preferred stock—par $100—of the Great Eastern Telephone Company were sold. The entire lot brought $13. This company was incorporated in 1905 under the laws of South Dakota, and has an authorized capitalization of $15,000,000, 6 per cent cumulative preferred and $15,000,000 common. It controls the Great Eastern Telephone Company of New York, which in April, 1909, increased its authorized capital from $1,000,000 to $50,000,000. The company claims franchises to lay wires in the boroughs of Brooklyn and Manhattan, New York City.

Louisville Lighting Company.—The directors of the Louisville Lighting Company, which is owned by the Louisville Gas Company, have decided upon a financing plan which will raise about $1,500,000, to be expended in new power house machinery, in extensions of lines and in liquidation of the floating debt. A bond issue of $1,000,000 will be made, the dividend on the Gas Company stock passed and an issue of short term notes made. The new securities will be entirely subscribed by the stockholders.

Edison Electric Illuminating Company, Boston.—The Massachusetts Gas Commission has authorized the issue of 19,452 new shares of stock by the Edison Electric Illuminating Company, of Boston. This stock will be offered for subscription to the present stockholders early in January. At the same time the stockholders will be asked to approve of the increase in capital which the issue represents. The stock will be offered at $215 per share.

United Electric Securities Company.—Perry, Coffin & Burr, bankers, of Boston, are offering to the public $500,000 of the 5 per cent bonds of the United Electric Securities Company which are due in 1939. The price at which these bonds are offered is 102 and interest. The company pays 7 per cent dividends on $1,000,000 of preferred stock, and showed a surplus on Aug. 1, 1909, of $1,316,079 over all liabilities.

Twin City Rapid Transit Company.—The report for November of the Twin City Rapid Transit Company shows gross earnings of $580,794, as against $526,574 the year previous. This large gain is indicative of the rapidity with which the earnings of this property are increasing. The total surplus for the first eleven months of 1909, after deducting fixed charges and preferred dividends, was $1,842,379.

Washington Water Power Company.—Official announcement has been made that at a special meeting of the stockholders of the Washington Water Power Company, in Spokane, Wash., on March 15, a proposal will be submitted to increase the authorized issue of stock from $10,000,000 to $15,000,000, with a par value of $100 a share. There is now outstanding $7,200,000 of stock and $5,974,000 of 5 per cent bonds. The present stockholders will have the privilege of subscribing to the new issue at par. The company is constantly extending its transmission lines and making additions to its plants, and the report for 1909 will show a decided increase in earnings over the previous year. Henry M. Richards, president of the company, will become chairman of the board of directors. He will be succeeded as president by David L. Huntington, now vice-president and manager.

Brunswick, Ga., Terminal and Railway Securities Company.—It is announced that the $2,000,000 additional capital stock which has been issued by the Brunswick, Ga., Terminal & Railway Securities Company will be used to take up all of the outstanding stock of the Mutual Light & Water Company, and to take up the bonds and outstanding stock of the City and Suburban Railway Company, of Brunswick. After these purposes have been accomplished there will be $50,000 additional cash left for working capital. The Brunswick Company now holds 1426 acres of land adjacent to the city and 1500 parcels of land within the city limits. It is figured that the net income derived from the properties will enable the company to improve this real estate, and greatly strengthen its material resources. The outstanding stock of the company is now $7,000,000.

Reedy River Power Company.—It is estimated that the gross earnings of the Reedy River Power Company, of Laurens, S. C., for its first year will amount to about $36,275, and that the net earnings available for interest charges will approximate $30,000. As the fixed charges are only $6,250, it appears that the company will have a comfortable surplus for the first year of its operation. The company's plant was not entirely completed until July 1, and is said to be of the most modern character in construction and equipment. The total cost of construction was $220,894. The company will furnish 133 hp to the city of Laurens, at $50 per horse-power per year, and already has contracts with one of the three large cotton mills that are located at this point.

Electric Storage Battery Company.—The raising of the dividend on the stock of the Electric Storage Battery Company from 3 to 4 per cent indicates the rapid recovery of that industry from the late depressions. It is stated that the demand from the railroads for storage batteries in connection with car lighting on passenger trains is increasing rapidly, and that the company is now negotiating with some of the transcontinental lines for several large contracts in that connection. The development of water power companies also means a larger use of the product of the Storage Battery Company. The increased use of electric pleasure and commercial vehicles is adding largely to the revenue of the company.

United States Light and Heating Company.—The earnings of the United States Light & Heating Company for the first year of its existence are said to have been largely in excess of the amount necessary to meet the 6 per cent cumulative dividend upon the preferred stock. This company, it will be remembered, was formed about a year ago as a consolidation of the Bliss Car Lighting Company, the National Battery Company and the United States Light & Heating Company, of New Jersey. The authorized capital of the company was $17,500,000. Of this amount it is stated that at the present time $1,500,000 of preferred has been issued, and $10,500,000 of common.

Lynn (Mass.) Gas & Electric Company.—The official report of the Lynn Gas & Electric Company for the last fiscal year showed that the company paid dividends of approximately 30 per cent and in addition added about $300,000 to its surplus account. The income from the sale of gas was $446,201 and from the sale of electricity was $367,408.

Waycross (Ga.) Electric Light & Power Company.—The plant and holdings of the Waycross (Ga.) Light & Power Company have been sold for $75,000 to Burdett Loomis, who will commence work immediately upon the construction of an entirely new power station.

Delaware & Atlantic Telegraph & Telephone Company.—The Delaware & Atlantic Telegraph & Telephone Company has filed an amended certificate of incorporation increasing its capitalization from $400,000 to $10,000,000.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 3.

W. S. Barstow & Company, New York, semi-annual, 5 per cent, payable Dec. 28.

Bell Telephone Company, of Pennsylvania, quarterly, 1½ per cent, payable Jan. 15.

Boston Suburban Electric Company, preferred, quarterly, $1 per share, payable Jan. 15.

Gamewell Fire Alarm Telegraph Company, quarterly, 1¼ per cent, payable Jan. 3.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable Jan. 15.

Mexican Light & Power Company, preferred, initial, 1¼ per cent, payable Jan. 3.

National Carbon Company, quarterly, 1½ per cent, payable Jan. 15.

National Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Ottawa Light & Power Company, quarterly, 1 per cent, extra, 1 per cent, payable Jan. 1.

Pioneer Telephone & Telegraph Company, Oklahoma, quarterly, 1¾ per cent. extra, 1 per cent, payable Dec. 31.

Porto Rico Railways Company, preferred, quarterly, 1¾ per cent, payable Jan. 10.

Public Service Corporation of New Jersey, quarterly, 1¼ per cent, payable Dec. 31.

Public Service Investment Company, Boston, preferred, quarterly, 1½ per cent; common, semi-annual, 1¼ per cent, both payable Feb. 1.

United States Smelting & Refining Company, preferred, quarterly, 1¾ per cent; common, quarterly, 1 per cent, both payable Jan. 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Canton (Ohio) Electric Company:					
November, 1909	$24,179	$10,583	$13,596	$2,944	$10,652
November, 1908	20,796	10,737	10,059	2,685	7,374
Cape Breton Electric Company, Ltd.:					
October, 1909	23,228	12,236	10,991	4,108	6,883
October, 1908	22,166	12,750	9,415	4,039	5,375
Central & South American Telegraph Company:					
Year, 1909 (estimated)	1,645,500	658,000	987,500	.....	363,240
Year, 1908	1,664,506	667,100	987,346	.....	328,528
El Paso (Texas) Electric Company:					
October, 1909	58,346	35,711	22,635	8,420	14,214
October, 1908	44,912	33,544	11,358	7,106	4,261
Houghton County (Mich.) Electric Light Company:					
October, 1909	22,850	10,463	12,387	3,640	8,000
October, 1908	23,273	11,171	12,101	3,309	8,021
Jacksonville (Fla.) Electric Company:					
October, 1909	41,566	22,136	19,430	8,410	11,020
October, 1908	38,509	21,144	17,364	8,144	9,219
Keystone Telephone Company:					
November, 1909	91,851	45,611	46,240	24,634	21,606
November, 1908	88,377	42,701	45,676	34,389	11,287
Philadelphia Company, Pittsburgh:					
November, 1909	1,701,493	962,855	738,638	592,622	340,768
November, 1908	1,453,977	804,374	649,603	261,400	568,562
Tampa (Fla.) Electric Company:					
October, 1909	50,759	26,791	23,967	3,873	20,094
October, 1908	47,354	30,169	17,184	3,630	13,553
Twin City Rapid Transit Company:					
November, 1909	580,794	273,044	307,750	140,250	167,500
November, 1908	526,574	259,780	266,794	143,667	123,127

General News

Construction News.

EUTAW, ALA.—The Eutaw Water Works Electric & Power Company contemplates the installation of ice machinery.

HUNTSVILLE, ALA.—The City Council has appointed a committee to confer with the Huntsville Railway & Power Company in regard to a contract for street lighting. If satisfactory terms cannot be made with the company, it is said that the city will issue bonds and establish a municipal electric plant.

MONTGOMERY, ALA.—The City Council, it is reported, will consider the question of installing electric pumps to duplicate the present reciprocating pumping plant and electric pumping plant for industrial water supply purposes. A. R. Gilchrist is city engineer.

IMBODEN, ARK.—The local electric light and water plant was sold at auction Dec. 20 to Dr. E. N. F. Sullivan, of Imboden, for $1,000. The plant was owned by the Imboden Power & Development Company, of which J. J. Estes was receiver. The new owner, it is said, proposes to remodel the electric light and water systems, wire the town, and reduce the prices for electricity and water.

MURFREESBORO, ARK.—Preparations are being made by the Pike County Water Power Company for the construction of a hydroelectric power plant, work on which, it is expected, will commence within six months. It is estimated that 8000 hp can be developed, which will be transmitted by electricity to Hot Springs, Ark., 50 miles distant, and to Little Rock, a distance of 106 miles. The cost of the plant is estimated at $600,000. Claudius Jones is president, and Fuller, Coult & Co., Chemical Building, St. Louis, Mo., are engineers. The main office of the company is located at Little Rock, Ark.

MERCED, CAL.—Preparations are being made by the Merced Falls Gas & Electric Company for the construction of a new substation near its plant on Fifteenth Street in Merced.

NEWPORT BEACH, CAL.—At a recent election the citizens voted to issue $25,000 in bonds for the purchase of the property of the Home Gas & Electric Company, to be operated as a municipal plant and $10,000 to purchase and extend the water-works system.

ONTARIO, CAL.—The City Council has sold a franchise to W. G. Kerhoff, representing the Pacific Electric Railway, for an electric railway to enter the northern part of Ontario.

RED BLUFF, CAL.—The City Trustees have granted the Sacramento Valley Power Company a franchise to erect transmission lines in Red Bluff for the distribution of electricity for lamps and motors.

RED BLUFF, CAL.—The directors of the Sierra Power Company have decided to keep at work during the winter on the construction of the ditch which is to convey the waters from Digger and Rock creeks to the reservoir, which it is expected will be completed by next spring. The company has secured 500 in. more of water by the purchase of the Head and Crozier ranches. A. T. Forward is local manager.

SAN BERNARDINO, CAL.—Application has been made to the Board of Supervisors by W. W. Poole for a franchise to construct an electric rialway from the Riverside-San Bernardino County line toward Rialto.

SACRAMENTO, CAL.—The contract for lighting the streets and public buildings has been awarded to the Sacramento Electric, Gas & Railway Company for a term of one year. Under the contract the rate for arc lamps will be $6.30 per lamp per month.

SAN LEANDRO, CAL.—The Suburban Light & Power Company has been awarded the contract to supply 19 arc lamps on the county road between Hayward and San Leandro, at the rate of $5 per lamp per month.

ST. HELENA, CAL.—Plans have been completed by the Napa Valley Electric Company for furnishing electricity for lamps and motors to the Veterans' Home. It is proposed to extend the transmission line to Yountville and from there to the Home. Electrical service will be furnished in Rutherford and Oakville. Work will commence on the proposed extension as soon as possible.

BOULDER, COL.—Preparations are being made by the Primos Mining Company for the construction of a power plant to cost about $100,000, for which surveys and filings have been made. The pipe line will be three miles long and the water will be taken from a point on North Boulder Creek above the Bluebird mine. The power site will be located at Lakewood. Electricity generated at the plant will be transmitted a distance of five or six miles to the new mill of the company, which is being built at a cost of $50,000. The mill and drills will be operated by electricity. The plant will furnish power to operate a tram from the Sugar Loaf to Gordon Gulch and the Boulder County mill. The company will also furnish electrical power to other companies in this district. C. F. Lake is manager of the company.

TRINIDAD, COL.—The Colorado Railway, Light & Power Company has been incorporated with a capital stock of $5,000,000 for the purpose of taking over the property and holdings of the Southern Colorado Power & Railway Company. The old company was capitalized at $1,500,000 and has bonds outstanding for the same amount. The new company will take up these bonds and make a new issue of $5,000,000. It is said that the new company will increase the output of the plant from 1500 to 15,000 hp and expects to furnish electricity for the entire district near Trinidad. The old company operated the street railway system in Trinidad and furnished electricity for lighting the city. J. J. Henry, of Denver, Col., was president of the Southern Colorado Power & Railway Company.

EAST HAMPTON, CONN.—Owing to the breakdown of the water wheel at the plant of the East Haddam Electric Light Company, at Leesville, Conn., the town has been without street lamps for the past week. A new water wheel has been ordered, and it is hoped to have the present wheel repaired and resume operations in the near future. E. Elmore, of Hartford, is president of the company, and E. W. Crocker, of East Hampton, is superintendent.

MANCHESTER, CONN.—Arrangements have practically been completed by the Glastonbury Power Company to commence work on the construction of a large electric power plant next spring, as soon as the frost is out of the ground.

NEW HAVEN, CONN.—Plans are being prepared by the New England Engineering Company for the installation of a new power plant at the New Haven Hospital. A refrigerating plant will also be installed.

LAUREL, DEL.—The Sussex Light & Power Company, recently incorporated, will take over the plant and holdings of the Laurel-Seaford Electric Company. The officers of the Sussex Light & Power Company are: William M. Cooper, of Salisbury, Md., president; Mark Cooper, of Salisbury, Md., secretary; Jesse D. Price, of Salisbury, Md., treasurer, and Charles C. Stephenson, of Laurel, Del., manager.

SEAFORD, DEL.—A movement is on foot to form a stock company and erect an electric light plant in Seaford for the purpose of furnishing electric service in opposition to the Laurel-Seaford Electric Light Company which now supplies electricity for lighting the town. The company will begin with a capital of $25,000.

WASHINGTON, D. C. (TAKOMA STATION).—Bids will be received by Captain H. L. Pettus, constructing quartermaster, Washington, D. C. (Takoma Station), until Jan. 29 for an extension of the electric lighting system at the Walter Reed Army General Hospital, Washington, D. C. Plans and specifications can be seen at the above office.

ATHENS, GA.—The Athens Electric Railway Company has been granted a franchise by the City Council covering an extension of a number of lines in Athens, under the terms of which the company is required to pay over to the city a percentage of its gross receipts, this percentage to increase by periods of 10 and 20 years.

ATLANTA, GA.—We are informed that Louis B. Magid, president of the Piedmont Power Company, of Atlanta, Ga., is not interested in a street railway project at Tallulah Falls, as reported in these columns Dec. 23. Mr. Magid states that the Piedmont Power Company is interested in a large water power development, by which it is estimated that 20,000 hp will be developed.

CUTHBERT, GA.—The contract for improvements to the electric light plant has been awarded to J. B. McCrary & Co., engineers, of Atlanta, Ga.

WAYCROSS, GA.—The Waycross Electric Light & Power Company is reported to have sold its plant and holdings to Burdett Loomis and associates for $75,000. The new company will commence work at once on the construction of a new plant. The old plant will be used until the new plant is completed.

BOISE, IDAHO.—The question of installing a municipal lighting system in Boise is under consideration. It is estimated that a plant can be installed at a cost of about $75,000.

AUBURN, ILL.—The Illinois Traction Company has accepted a franchise from the City Council of Auburn to construct a system through Auburn. The company refused to accept the terms offered by the City Council three years ago and built the railway around the city.

EAST ST. LOUIS, ILL.—Plans are being made by the East St. Louis, Columbia & Waterloo Railway Company to commence work on its proposed railway this spring, which is to connect East St. Louis, Dupo, Bixby, Columbia and Waterloo, 24 miles in length. Nearly all of the right-of-way has been secured and part of the material ordered. H. Reichenbach, of Columbia, is secretary and treasurer.

SIGEL, ILL.—Plans have been made by the Sigel Mutual Telephone Company for the erection of an independent telephone line into Effingham, where arrangements have been made for connections with the local telephone system in that city.

SPRINGFIELD, ILL.—The Springfield & Jacksonville Interurban Railway Company has been granted a franchise by the Sangamon County Board of Supervisors to construct an interurban railway along the highway between Springfield and the western boundary of the county. The company proposes to build an electric railway from Springfield to Jacksonville.

WAUKEGAN, ILL.—The Illinois Lakes Light & Power Company has applied to the Board of Supervisors of Lake County for a franchise to erect and maintain a telephone system in Lake County. The company is capitalized at $250,000. It owns the electric and telephone systems in Crystal Lake and is negotiating for the power plants at Barrington, Grayslake and Antioch. It proposes to furnish electricity for lamps and motors as well as telephone service throughout the western part of Lake County and the eastern part of McHenry County. The company also owns lighting plants in Cook County.

EVANSVILLE, IND.—Plans have been prepared by the Evansville Public Service Company for the construction of an electric plant with an output of 4000 kw. The steam heating plant will provide for 500,000 ft. of radiation surface, and the hot water heating plant will be equipped to care for 350,000 square ft. of radiation surface.

FORT WAYNE, IND.—The Wayne Paper Mills Company, recently incorporated, proposes to erect a large plant for the manufacture of paper and paper products. The plant will be operated by electricity and will call for installation of a large amount of electrical equipment. Charles McCulloch, Henry C. Paul, Louis Fox and C. H. Worden are directors.

HAMMOND, IND.—It is reported that preparations are being made by the Northern Indiana Gas & Electric Company for the construction of a new electric plant in Hammond. The new plant will have an output of 12,500 hp and will furnish electricity to operate the Gary and Interurban Railway Company. The output of the present plant of the company is 4000 hp. C. H. Geist is president of the company.

INDIANAPOLIS, IND.—The Direct Drive Manufacturing Company proposes to establish and equip a factory for the manufacture of automobile parts, including a newly patented transmission gear. The factory will be equipped to be operated by both steam power and electricity. Wallace M. Parkinson, William H. Parkinson, A. C. Downing and E. R. Hall are directors.

MONTICELLO, IND.—Arrangements are being made by the Tippecanoe & Monticello Interurban Company to begin work on the construction of its proposed railway in the early spring. The railway will be 36 miles in length and will connect Monticello and Winamac and intervening towns. The motive power will be either electricity or gasoline. William R. Felker is president and W. R. White, secretary and general manager, both of Monticello, Ind.

OAKLAND CITY, IND.—The Oakland City Electric Light & Power Company is making arrangements to establish a day service and expects to have the plant equipped for the additional service early in the spring. The company also proposes to install an ice plant to be operated in connection with its electric plant.

PENDLETON, IND.—Plans are being prepared by the Pendleton Light & Power Company, recently organized, for the construction of an electric light and power plant. The company has been granted a 10-year franchise, which calls for the completion of the plant by July 1. J. P. Taylor is vice-president and J. B. Parsons, secretary and treasurer of the company.

BELLEVUE, IA.—The municipal electric light plant and water works systems are reported to have been destroyed by fire, causing a loss of $6,000.

CEDAR RAPIDS, IA.—It is reported that Douglas & Co., of Cedar Rapids, Ia., will soon place contracts for power and electrical equipment for its new factory buildings.

CHARLES CITY, IA.—The George P. Smith Company, of Charles City, Ia., is contemplating enlarging its factory. An electric generator and engine and other machinery will probably be needed.

CLARINDA, IA.—It is reported that the citizens of Clarinda have offered the promoters of the St. Joseph-Savannah Interurban Railway a bonus of $38,000 to extend the proposed railway to Clarinda. J. H. Vanbrunt, of St. Joseph, Mo., is general manager.

DAVENPORT, IA.—The City Council has approved and recommended for adoption the 25-year franchise applied for by the Davenport Water Power Company. The company proposes to construct a hydroelectric power plant on the Mississippi River, a short distance from the Iowa end of the Government bridge, at a cost of between $2,000,000 and $4,000,000. One of the provisions of the ordinance is that the franchise shall not become effective until 15,000 cu. yd. of concrete construction shall have been placed in the river. Under the terms of the franchise the wires of the company are to be placed underground in the fire limits of the city. The company proposes to utilize the water power of the Davenport-LeClaire Rapids in the Mississippi River. About 16,000 hp will be developed.

SIOUX CITY, IA.—At an election held recently the citizens voted against the proposition to grant franchises to the Sioux City Service Company and the Sioux City Gas & Electric Company.

HUTCHINSON, KAN.—Plans are being made for the reorganization of the Water, Light & Gas Company of Hutchinson, Kan., which was recently placed in the receiver's hands, in the near future. A charter has been granted to the new company under the name of the United Water, Gas & Electric Company, with a capital stock of $200,000. The new company proposes to enlarge and improve the plant. Among the incorporators are: J. D. Houston, R. S. Elder, Leland Scroggins and F. W. Wetmore, of Wichita, Kan. Houston & Brooks, of Hutchinson, Kan., are attorneys. J. F. Springfield, of Hutchinson, is receiver and manager of the Water, Light & Gas Company.

OSWEGO, KAN.—The local electric light plant has been purchased by Oswego capitalists, who have organized the Oswego Electric Light, Power & Plumbing Company. The new company will make improvements to the plant and establish a 24-hour service.

BARBOURSVILLE, KY.—The plant and holdings of the Barboursville Electric Light, Heat & Power Company are reported to have been purchased by Pineville, Ky., capitalists. It is said that the new owners will make improvements to the system.

LOUISVILLE, KY.—Plans are being considered by the Louisville Lighting Company for extensive improvements and extensions to its system, which will involve an expenditure of about $1,500,000. Among the improvements to be made is the installation of new machinery at the plant located at Fourteenth Street and Broadway, at a cost of $200,000. F. M. Sackett is president of the company.

PARIS, KY.—The City Council has granted a 20-year franchise to the Paris & Cynthiana interurban electric railroad in Paris. The company is constructing an electric railway between the two cities.

BELFAST, MAINE.—The Penobscot Bay Electric Companp has installed five new street lamps of 75 cp on High Street for trial. If the lamps are satisfactory the company will replace the present arc lamp system with the new lamps.

SANFORD, MAINE.—Arrangements are being made to equip the Douglas Shoe factory to be operated by electricity.

RANDALLSTOWN, MD.—The residents of Randallstown are making arrangements to establish an electric lighting service for the village and have taken up the proposition with the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., to extend its transmission line from Pikesville to Randallstown.

UPTON, MASS.—The plant of the Upton Electric Light Company is completed and now furnishing electrical service in Upton.

MALDEN, MASS.—The Board of Aldermen has authorized the Mayor to enter into a contract with the Malden Electric Company for lighting the streets of the city for a term of ten years, under which the company is to furnish 161 arc lamps at $76.63 each per year and 583 incandescent lamps at $14.22 each per year. Under the old contract the city paid $88 each for arc lamps and $15 per lamp for incandescent lamps.

WALTHAM, MASS.—The city has entered into a contract with the Edison Electric Illuminating Company for lighting the streets and public buildings for a term of ten years, beginning from Sept. 1, 1909. Under the terms of the contract the company is to furnish 506 incandescent electric lamps at the rate of $10.80 each per year and 164 arc lamps at $36 per lamp per year, with an all night service. Under the new contract the city will save about $805 per year.

WEST BOYLSTON, MASS.—At a special town meeting held Dec. 20, the citizens voted to construct an electric light system, electricity for operating the same to be purchased from the Connecticut River Power Company. An appropriation of $15.000 was made to provide for the construction of 12 miles of transmission line and 165 lamps. The plant will be built under the supervision of the Selectmen, work on which will begin at once. It is expected to have the plant ready for operation by July 1.

JACKSON, MICH.—W. A. Foote, president of the Commonwealth Power Company, of Jackson, Mich., is reported to have announced that arrangements have been completed whereby the Commonwealth Power Company will acquire the Grand Rapids-Muskegon Power Company, the undeveloped Ausable River power property, owned by the Louds, and the electric properties at Saginaw, Bay City and Flint. The capitalization of the Commonwealth company will be increased from $6,200,000 to $8,750,000. It is said that electricity generated by the Ausable River power will be transmitted to Jackson, a distance of more than 200 miles.

BLUE EARTH, MINN.—C. O. Anderson is reported to be interested in a project to organize a company to construct an electric railway to connect Pilot Grove, East Chain, Center Chain, Ceylon and Estherville. The company will operate under the name of the People's Electric Road Association.

CANNON FALLS, MINN.—It is reported that H. M. Byllesby & Company, of Chicago, Ill., have purchased the property of the Faribault Gas & Electric Company and also the Cannon Falls water power. It is said that arrangements have been made for the erection of a transmission line to Northfield and Faribault, work on which will commence during the coming summer.

MINNEAPOLIS, MINN.—The directors of the Minneapolis General Electric Company have called a meeting of the stockholders for Jan. 17 to vote on the proposition to issue bonds to the amount of $1,000,000, to be sold to the stockholders at par.

PROCTOR, MINN.—The Village Council has granted a franchise to the Duluth Telephone Company.

WARREN, MINN.—The Electric Light and Water Department of Warren, Minn., would like information regarding the cost of constructing concrete chimneys; also printed matter regarding motor-driven deep well pumping machinery.

MACON, MISS.—Bids will be received at the office of the Board of Mayor and Aldermen until Jan. 17 for a compound high-speed engine, two 2300-volt, three-phase generators and exciters, three 2300-volt, three-

phase, vertical motors, one three-panel switchboard and instruments, series street lamps, three vertical turbine pumps, feed water pump, closed feed water pump, ejector condenser and check valve, etc. Plans and specifications are on file at the office of the board. G. B. Baskerville, Jr., of Macon, is engineer.

CHARLESTON, MO.—The Southeast Missouri Light, Ice & Power Company is contemplating the construction of a new power plant to cost approximately $15,000, plans for which have been prepared by Matthews & Clarke, Missouri Trust Building, St. Louis, Mo.

CHILHOWEE, MO.—The Chilhowee Telephone Company, recently incorporated, proposes to erect a telephone exchange in Chilhowee and make toll connections with other lines. John Wantland is president and William Sweeney is manager.

CHILLICOTHE, MO.—At an election held Dec. 23 the citizens voted in favor of the proposition to issue $50,000 in bonds for an electric light plant.

HUNTSVILLE, MO.—The City Council is considering the question of calling an election to vote on the proposition to issue bonds to purchase the local electric light plant and install a water works system. J. B. Holman is clerk.

KANSAS CITY, MO.—The Electric Traction Company, Commerce Building, Kansas City, Mo., which is constructing an electric railway for the Interstate Railway Company, extending from Kansas City to St. Joseph, Mo., 48½ miles in length, is in the market for materials for the proposed railway, including electrical machinery, cars, bridge material, etc.

MARYVILLE, MO.—We are informed that the Maryville Electric Light & Power Company contemplates the installation of a 250-hp water tube boiler during the spring or summer of 1910. C. C. Hellners is secretary and manager.

SAVANNAH, MO.—Application will soon be made by J. H. Van Brunt, general manager of the St. Joseph Railway, Light, Heat & Power Company; Davis Brothers and Charles W. W. Campbell, of St. Joseph, Mo., to the county court of Andrew County, for a franchise in connection with the St. Joseph-Savannah interurban railway. It is said that rights-of-way have been secured for the proposed railway between St. Joseph and Savannah. Arrangements are being made with the street railway company to furnish electricity for street lighting in Savannah as soon as the interurban railway is completed.

SEDALIA, MO.—The Sedalia Light & Traction Company on Dec. 22 issued an ultimatum to the city of Sedalia that unless the City Council repealed an ordinance passed at the last meeting of the Council fixing the maximum price for arc lamps for street lighting at $60 each per year, the company would cease its service on Dec. 31. This action would leave the streets of the city in darkness. The traction company has no contract with the city, but has been furnishing street lighting service at the rate of $75 per arc lamp per year. The ultimatum has been issued by the company to force the city into a contract for a number of years at its own terms.

GREAT FALLS, MONT.—Application has been made by the Rocky Mountain Telephone Company to the City Council for a 24-year franchise in Great Falls.

BURWELL, NEB.—F. M. Currie, of Broken Bow, Neb., is interested in a proposition to establish a hydroelectric power plant.

COZAD, NEB.—Bids will be received at the office of L. A. Quivey, village clerk, for the construction of a combined electric-lighting and water-works system for the Village of Cozad until Jan. 17, as follows: Power house; one pump having 750,000-gal. capacity per day; one 75,000-gal. steel tank on 100-ft. tower; three 6-in. wells; steam engines approximating 100 hp; two 100-hp water-tube boilers, including two 100-ft. sheet steel stacks, steam piping for above; feed water heater, boiler-feed pump, etc.; one 30-kw alternating-current generator with exciter; one 50-kw generator with exciter; switchboard; pole line for electric light wires, including lamps, transformers, etc.; 1420 ft. of 8-in. cast-iron pipe; 3230 ft. of 6-in. cast-iron pipe; 15,052 ft. of 4-in. cast-iron pipe; 5200 ft. 2-in. cast-iron pipe and 31 hydrants, and necessary valves, fittings and specials as per plans. Bids will also be received on suction gas producers and two producer-gas engines of approximately 40 to 50 hp and 65 to 75 hp, respectively. Bids may be made on the entire work or on each portion. Bids must be made on blanks furnished by the village. Plans and specifications can be seen at the rooms of the Commercial Club, of Cozad, Neb., and at both banks in Cozad, or at the office of Hershey S. Welch, at North Platte, Neb. W. E. Hart is chairman.

FREMONT, NEB.—At the annual meeting of the Fremont Gas & Electric Light Company the company decided to make improvements to its system during 1910, which will involve an expenditure of $25,000. H. L. Doherty is president and W. B. Stark manager of the company.

MANCHESTER, N. H.—The Welsbach Street Lighting Company of America, which has the contract for lighting the city with gas and gasoline lamps, has notified the City Council that it will not renew the contract which expires January 19, 1910. At present the city has 112 gas lamps and 106 gasoline lamps, which are cared for by the Welsbach company. Owing to the large territory covered by the lamps the company claims that the contract has been carried out at a loss and that it will not consider a renewal of the contract at an advanced rate per lamp, as it considers the amount now paid, $600 per month, as sufficient and could be done for that amount by a local company. The City Council has decided to ask the Manchester Light & Power Company and the People's Gas Light Company to submit bids for lighting the territory.

MONTCLAIR, N. J.—The Town Council has engaged Runyon & Carey, of Newark, N. J., to make investigations and submit a report on the cost of establishing a municipal electric plant before next November, when the contract for street lighting with the Public Service Corporation of New Jersey expires. The construction of a garbage disposal plant is under consideration.

TRENTON, N. J.—The Delaware & Atlantic Telegraph & Telephone Company, a branch of the Bell system, has increased its capital stock from $400,000 to $10,000,00. U. N. Bethel is president and U. S. Peirsol is secretary of the company.

FORT BAYARD, N. M.—Bids will be received by Captain S. P. Vestal, constructing quartermaster, until Feb. 15 for construction, plumbing, heating, electric light wiring and electric light fixtures for one double set of hospital sergeants' quarters and power plant with machinery for refrigerating and electric lighting systems at Fort Bayard, N. M.

ROSWELL, N. M.—Joseph M. Swazier, of El Paso, Tex., has recently been in Roswell, making investigations in regard to establishing an electric plant in the valley in the near future. Mr. Swazier and associates propose to erect an electric power and pumping plant on the Pennsco River, for which water rights have already been secured.

AMSTERDAM, N. Y.—Arrangements are being made by the Shuttleworth Brothers Company, of Amsterdam, N. Y., for the installation of a new power plant, with a rating of from 300 to 350 hp. The equipment will include boilers, engine, generator, heater, pumps, condenser, etc.

BROOKLYN, N. Y.—Application has been made to the Public Service Commission, First District, for a certificate of convenience and necessity to construct an electric railway from the Hudson River across Manhattan, through Canal Street, over the New Manhattan Bridge and through Brooklyn to Atlantic and Flatbush Avenues by the new company, recently incorporated, under the name of the Manhattan Bridge Three-Cent Line. The company is capitalized at $50,000. Frederick W. Rowe, of Brooklyn, is president of the company, and John C. Breckenridge is vice-president.

HAMBURG, N. Y.—A $30,000 mortgage has been filed by the Hamburg Water & Electric Light Company in favor of Otho Churchill, as trustee, to secure an issue of bonds.

HORNELL, N. Y.—The Public Service Commission, Second District, has authorized the Hornell-Bath Interurban Railroad Company to issue $250,000 in capital stock and $450,000 in bonds for the construction of its railway.

JOHNSBURG, N. Y.—The North Creek Electric Company has applied to the Public Service Commission, Second District, for permission to exercise a franchise granted by the Town of Johnsburg and to erect an electric plant in Johnsburg. The company proposes to construct a hydroelectric power plant and to secure water from Long and Clear ponds.

LYONS, N. Y.—Arrangements are being made by the William T. Morris interests, of Penn Yan, which recently purchased control of the Wayne County Electric Company, to enlarge the local plant so as to furnish electricity for lamps in Palmyra, Newark, Lyons and Clyde, from Lyons. The local plant has a valuable water power. It is also proposed to erect a central plant in Newark to furnish gas in the above named villages, the Morris interests having secured control of the gas companies of these towns.

MIDDLETOWN, N. Y.—Plans are being considered by the Wallkill Transit Company for considerable extensions to its system in Orange County next spring, which will include the construction of a railway from Goshen to Montgomery, a distance of 10 miles. The company now operates an electric railway from Middletown to Goshen, eight miles in length. D. C. McMonigle is president and manager of the company.

NEWBURGH, N. Y.—It is understood that the Orange County Traction Company, which operates the local street railway system and a line to Walden, 12 miles distant, is contemplating the construction of an extension from Walden to Montgomery, where it will connect with the system of the Wallkill Transit Company. B. B. Odell, Jr., is president of the company.

OSWEGO, N. Y.—The contract for lighting the streets of the city and the city hall has been awarded to the People's Gas & Electric Company. Under the terms of the contract the company is to furnish arc lamps at the rate of $66 each per year, incandescent street lamps at $18 per lamp per year and 427 incandescent lamps of 16 cp at $3.65 each per year. There are now 328 arc lamps in use at present. The contract is for a term of five years and aggregates about $26,000 a year.

PLATTSBURGH, N. Y.—Plans are being considered by the City Council for the construction of a hydroelectric power plant, which will be built in connection with a 200-ft. impounding dam. Specifications have not yet been prepared.

RED HOOK, N. Y.—The capital stock of the Red Hook Telephone Company has been increased from $5,000 to $50,000.

RICHMOND, N. Y.—Bids will be received until Jan. 11 at the office of the Department of Charities, foot of East Twenty-sixth Street, New York, N. Y., for furnishing material and labor for the construction, including heating and plumbing and electric work, except lighting fixtures, refrigerators, etc., of a dormitory for female inmates at the New

York City Farm Colony, located on the property of the Department of Public Charities in the Township of Castleton, Borough of Richmond, New York. Blank forms and further information may be obtained at the office of Raymond F. Almirall, architect, 51 Chambers Street, New York, N. Y., where plans and specifications may be seen. Robert W. Hebberd is commissioner.

BLADENBORO, N. C.—A site, consisting of 200 acres of land, has been purchased in Bladenboro for a cotton factory. The company is capitalized at $200,000 and will erect mill buildings, houses for employees, construct water works system, electric light plant and provide other facilities for a complete mill town. H. S. Bridger, Sr., H. C. Bridger, Jr., E. C. Hester and N. M. Singletary are interested in the project.

ROXBORO, N. C.—Contracts have been awarded by the Roxboro Cotton Mills for a 100-hp engine direct connected to a 75-kw generator for its power plant. The contract for the electrical machinery was awarded to the General Electric Company, of Schenectady, N. Y.

WILMINGTON, N. C.—The Tidewater Power Company is contemplating the purchase of a 500-kw rotary converter and two 125-kw, 375-1000-volt transformers. A. B. Skelding, of Wilmington, N. C., is purchasing agent.

CENTER, N. D.—Plans are being considered for the construction of an electric railway to parallel at some distance the extension of the Northern Pacific Railroad from Mandan. It is proposed to build a large power plant in Center and make this place a division point. The railway will be known as the Hudson, Center & New Salem Electric Railway. Another line is also planned to Manning, N. D.

EDINBURG, N. D.—The capital stock of the Edinburg & Gardar Telephone Company has been increased from $10,000 to $20,000.

SCHAFER, N. D.—Preparations are being made by J. T. Spencer for the erection of a telephone line to Dickinson.

VALLEY CITY, N. D.—It is said that the North Dakota Heat & Power Company, of Fargo, N. D., will ask the City Council in the near future for a contract to supply electricity to operate the municipal electric light plant. The company has purchased large tracts of lignite coal lands near Minot, where it is building a large power plant. The company proposes to furnish electricity in Minot and other towns in that section of the State and will extend a transmission line down the Soo to Valley City and thence to Fargo. It will also furnish electrical service to towns between Minot and Valley City. It is understood that the company will offer to enter into a contract to supply the city with energy at the rate of 1½ cents per kw-hour.

CINCINNATI, OHIO.—The Park Commission has awarded the Union Gas & Electric Company a contract to install a complete lighting system in Inwood Park, to cost $4,980. The system will consist of 20 flaming arc lamps.

CLEVELAND, OHIO.—It is reported that the Peerless Motor Company will soon call for bids on an electric generating plant of 4500 hp. The equipment will include tubular boilers, automatic stocker, furnaces, heater, pumps, engines or turbines, condensers, alternating-current generators, exciters, motors, transformers, switchboard and other apparatus. It is said that motors and additional machinery will be purchased later.

CLEVELAND, OHIO.—Plans are being made for additions and improvements in the equipment of the Cleveland Railway Company's property, involving an expenditure of about $2,500,000 immediately after the approval of the franchise at a referendum election. The terms of the ordinance approved by Federal Judge Taylor and passed by the City Council to compel the immediate equipment of all cars of the system with the pay-as-you-enter fare box. Plans have already been prepared for an expenditure of about $1,000,000 on additional power equipment.

COLUMBUS, OHIO.—The Board of Penitentiary Managers has awarded the contract for the steam turbines to be installed in the new prison power plant to the Allis-Chalmers Company, of Milwaukee, Wis., for $33,800.

NILES, OHIO.—We are informed that the Hydro Electric & Gas Company will receive bids until about Jan. 15 for the construction of its proposed steam plant. The cost of the work is estimated at about $30,000. Byron T. Mottinger, of Warren, Ohio, is chief engineer.

OBERLIN, OHIO.—The Oberlin Telephone Company has increased its capital stock from $6,000 to $35,000.

SHERWOOD, OHIO.—The village of Sherwood has disposed of an issue of $4,000 in bonds, the proceeds to be used for the installation of an electric light plant. It is said that the plant will be built in the spring.

ZANESVILLE, OHIO.—The Zanesville & Meigs Valley Traction Company has been granted a 25-year franchise by the County Commissioners for an electric railway through Morgan County. The company is planning to construct a railway from Zanesville to Beverly, via McConnellsville. H. D. Blodgett, of Zanesville, Ohio, is general manager.

ZANESVILLE, OHIO.—The County Commissioners of Morgan County have granted a 25-year franchise to the Zanesville & Meigs Valley Traction Company to construct and operate an electric railway in Morgan County. The company has obtained a franchise in Muskingum County and has applied to the Commissioners of Washington County for permission to construct and operate a railway in that county. A. G. Herrington has charge of the engineering work and H. D. Blodgett is general manager of the company.

OKLAHOMA CITY, OKLA.—Plans are being made by the Oklahoma Railway Company for extensions and improvements to its system, which will involve an expenditure of more than $1,000,000 during the coming year. The present plans call for the building of 32 miles of suburban trackage and the extension of interurban lines into Moore, Yukon and Edmond by the end of 1910.

RUSH SPRINGS, OKLA.—The Chickasha Water Power Company is reported to be making arrangements to extend its transmission line from Chickasha to Rush Springs. The line has been completed as far as Ninnewah. It is said that farmers along the line will use electricity for lamps.

THOMAS, OKLA.—Plans are being considered by the city for enlarging the municipal electric light plant, which will involve an expenditure of about $12,000. F. Murck & Company, of Clinton, Okla., are engineers.

AMBRIDGE, PA.—The Ambridge Borough Light, Heat & Power Company, which is constructing an electric plant in Ambridge, expects to have its plant ready for operation by Oct. 1. The company has a perpetual franchise in Ambridge and an eight-year contract to furnish electricity for street lamps for the borough. It also has secured a 25-year franchise in the Borough of Sewickley, under the name of the Sewickley Borough Light, Heat & Power Company, which is owned by the Ambridge Borough Light, Heat & Power Company. The Sewickley company has a contract for lighting the Borough of Sewickley for a term of seven years. The Ambridge Borough Light, Heat & Power Company is now making arrangements to secure franchises in the boroughs of Baden, Edgewood and Leetsdale. State charters will be secured for each of the boroughs separately to comply with the State law. The post office address of the company is Economy, Pa. The officers of the company are: John R. Minor, president; E. G. Schell, vice-president; W. Justus Walker, secretary and treasurer, and T. K. Bennington, superintendent.

ETNA (R. D. ALLEGHENY), PA.—The municipal electric light and water plant was entirely destroyed by fire Dec. 25, causing a loss of about $65,000. It is expected that the plant will be rebuilt.

ETNA (R. D. ALLEGHENY), PA.—The Borough Council has decided to equip two temporary plants to furnish electricity in the borough while the municipal electric plant, which was recently destroyed by fire, is being rebuilt. The Spang & Chalfant Company has offered to furnish electricity to operate the arc lamp system, while arrangements have been made with the Etna Supply Company to install machinery to furnish energy for the incandescent lighting system temporarily.

KUTZTOWN, PA.—The Kutztown Rural Telephone Company has increased its capital stock from $10,000 to $20,000. The directors are: Harry Reitz, A. A. Fisher, Charles A. Stein, Wilson Wert, Edwin D. Kistler and Solomon Rupp.

PALM, PA.—Plans are being made by a number of farmers along the State road from East Greenville to Palm, to construct a telephone line and connect with the Bell system at Palm.

PHILADELPHIA, PA.—Plans have been prepared by the Friedberger-Aaron Manufacturing Company, of Philadelphia, Pa., for a power plant to furnish electricity for its new factory. The equipment will include an engine, generators, motors, etc.

PITTSBURGH, PA.—Plans are being prepared for a large power plant for Pittsburgh, Chester & East Liverpool Street Railway Company. The company is also considering the question of making arrangements with one of the steel companies in the Pittsburgh District for a supply of electrical energy from a combination blast furnace gas and producer-gas plant.

HECLA, S. D.—It is reported that an electric lighting system is to be installed throughout the City of Hecla.

MEMPHIS, TENN.—The plans of the Clarksdale, Covington & Collierville Interurban Railroad Company are being enlarged, and now contemplate, in addition to the interurban railways at first proposed, four lines through the City of Memphis. Application has been made by the company for an amendment to its charter permitting it to do this. W. A. Percy is general counsel for the company.

MEMPHIS, TENN.—Contracts have been awarded by the Board of Education for heating and ventilation systems for the new high school building as follows: For the steam heating and ventilating system to the Southern Blower & Manufacturing Company, for $28,700; power plant equipment, switchboard, etc. to the Horstic Heating Company, for $11,220; electric wiring, etc., to the Electric Novelty Company, for $6,538, and for automatic temperature regulator to the National Regulator Company, for $4,545. H. B. Hill is secretary of Board of Education.

CANADIAN, TEX.—The capital stock of the Canadian Long-Distance Telephone Company has been increased from $20,000 to $40,000. The company proposes to extend its telephone line from Canadian to Amarillo, Tex.

CORPUS CHRISTI, TEX.—The Corpus Christi & Interurban Railway Company has nearly completed its street railway in Corpus Christi and expects to place it in operation within the next few weeks. Electricity for operating the railway will be secured from the plant of the People's

Light Company. V. S. Heinly, of Corpus Christi, Tex., is secretary and treasurer.

EL PASO, TEX.—We are informed that preparations are being made by the El Paso & Fort Hancock Railway Company to commence work Feb. 1 on its proposed railway to extend from El Paso to Yselta, a distance of ten miles. The motive power has not yet been decided upon. The company is capitalized at $100,000 and the officers are: C. N. Bassett, president; Felix Martinez, vice-president; Thomas O'Keefe, secretary, and Winchester Cooley, treasurer, all of El Paso, Tex.

GALVESTON, TEX.—It is reported that plans are practically completed for the construction of a network of electric interurban railways connecting all the large cities in Texas. The plans call for the construction of about 1,000 miles of road to be increased later by extensions to smaller towns and villages. Surveys have been made for the railway between San Antonio and Fort Worth, and San Antonio and Houston, and Dallas and Houston, forming a triangle of about 900 miles. It is said that construction work will commence within three months. It is planned to complete the Fort Worth and San Antonio division within 14 months after commencement of work. L. L. McSweeney, of New York, N. Y., and C. L. Hodges, of Chicago, Ill., are interested in the project.

VAN HORN, TEX.—It is reported that John E. Cox, owner of the Van Horn water works, contemplates the installation of an electric light plant to supply electricity for the entire town.

SALT LAKE CITY, UTAH.—Plans are being prepared by Gray & Grosh, consulting engineers, for the construction of a large heating and lighting plant to furnish electricity and heat for the many church buildings on and near Temple block. The cost of the plant is estimated at from $150,000 to $200,000.

SALT LAKE CITY, UTAH.—It is expected that the new franchise asked for by the Telluride Power Company for extending its high-tension transmission lines on the county roads will include a proviso that the company furnish electricity for lamps along the route. If this condition is included in the new franchise, it is expected that the lighting system at the mouth of Big Cottonwood will be restored. J. H. Scott, engineer for the Utah Light & Power Company, has been employed by the Board of Supervisors to make investigations of the lighting systems on the county roads.

RUTLAND, VT.—Surveys are now being made for the proposed extension of the Rutland Railway, Light & Power Company's electric railway system from Fair Haven and Lake Bomoseen to Lake St. Catherine, about 23 miles distant from Rutland. The extension will be about 12 miles in length and it is expected to have it completed for the summer traffic. George S. Haley is general manager.

NATIONAL SOLDIERS' HOME, VA.—Bids will be received at the office of treasurer of the Southern Branch of the National Home for Disabled Volunteer Soldiers, National Soldiers' Home, Va., until Jan. 11 for material and labor for remodeling the electric plant (poles, wires, etc.), in accordance with instructions and specifications, copies of which, with blank proposals and other information, may be obtained upon application to John T. Hume, treasurer.

RICHMOND, VA.—Sealed proposals will be received at the office of the superintendent of the Water Department, Richmond, Va., until Jan. 14 for furnishing material and electric transmission lines as per plans and specifications on file in the above office. E. E. Davis is superintendent.

GEORGETOWN, WASH.—Application has been made to the City Council by Robert M. Jones, representing the American Gas & Electric Company, a subsidiary company of the Northern Gas & Power Company, of Vancouver, B. C., Can., for a franchise to operate gas and electric plants in Georgetown. The franchise is for a term of 50 years, and work is to begin on construction of the plant within one year. Upon the expiration of the franchise the city has the privilege of purchasing the plant. Under the terms of the franchise the maximum price for gas is $1.50 per 1,000 cu. ft. for illuminating purposes and for heating purposes $1.25 per 1000 cu. ft. The present plans of the company contemplate the construction of a plant to cost $300,000.

MOOREFIELD, W. VA.—H. O. Barncord, of Midland, Md., and associates, who were recently granted an electric light franchise in Moorefield, are contemplating the construction of an electric plant, bids for the construction of which will probably be received about March 1. An agreement has been made with D. L. Wilson for furnishing water power to operate the plant.

GRAND RAPIDS, WIS.—Preparations are being made by the Consolidated Water Power & Paper Company, of Grand Rapids, Wis., to install a hydroelectric unit with a rating of 750 hp and accessories. Other machinery, including electric motors, will probably be required later.

GREEN BAY, WIS.—Plans are being made to enlarge the plant of John Hoberg Company, of Green Bay, Wis., which will include the erection of steel frame concrete mill, equipped with special paper-making machinery, power and pumping machinery. The mill will be equipped for electric-motor drive.

LA CROSSE, WIS.—The La Crosse City Railway Company, it is said, contemplates increasing the output of its plant to provide for the proposed extensions of its commercial lines and electric railway system. It is said that the equipment will probably include a turbine unit, car motors, compressors, air brakes, etc.

MARSHFIELD, WIS.—Plans have been prepared by the Upham Manufacturing Company, of Marshfield, Wis., to change its steam power plant into an electric-generating station and using motor drive throughout its plant. The present engine will probably be retained; a 300-kw generator will be needed.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company, it is said, will issue $114,000 in bonds, the proceeds to be used to increase the output of its power plant to 1500 hp, to double-track part of its railway system and make other improvements.

SHEBOYGAN, WIS.—Preparations are being made by the Porcelain Enameling Association of America to erect a large plant in Sheboygan, Wis., for which bids for steel work are now being asked. Machinery for the plant, including power and electrical apparatus, will not be purchased until later.

SHEBOYGAN, WIS.—The C. Reiss Coal Company is planning to construct a larger power plant on the site now occupied by dock No. 2, which will generate twice as much power as the present plant. The company has been granted a franchise by the Council to construct a tramway over Seventh Street, connecting two of its three docks in the local harbor. Work on construction of the tramway will soon commence.

WINNIPEG, MAN., CAN.—Bids will be received by the chairman of the Board of Control, Winnipeg, Can., for the supply and erection of the various portions of the equipment for the terminal station at Winnipeg, and for the turbine governors and gate valves for the generating station. Individual bids will be received for the following: 18-Terminal station. 19 and 20-Step-down transformers and terminal station switching and accessory apparatus. 21-Terminal station, light, heat and power systems. 22-Terminal station oil and water systems. 24-Testing transformers and apparatus. 26-Turbine governors (seven). 27A-Two five-foot gate valves. Copies of instructions to bidders, plans, specifications and forms of tender may be obtained at the power engineers' office, Carnegie Library Building, Winnipeg. Plans and specifications may also be seen at the offices of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ont., Can.

BRANTFORD, ONT., CAN.—By its agreement with the Western Counties Electric Company, which went into force at the beginning of 1909, the City of Brantford secured a reduction of $1800 in its lighting bill for the year, as well as having 17 additional arc lamps in operation. The rate per lamp was reduced from $55 to $48 under the terms of the agreement. In addition a reduction of 7 per cent was made to the citizens for electricity for lighting purposes.

CHATHAM, ONT., CAN.—The Board of Railway Commissioners has authorized the Chatham, Wallaceburg & Lake Erie Railway Company to construct and operate a branch line on several streets in Chatham.

NIAGARA FALLS, ONT., CAN.—Application has been made to the Canadian Parliament by the Niagara Falls, Welland & Dunnville Electric Railroad Company for permission to construct an electric railroad from Niagara Falls, Ont., to Dunnville, a distance of about 50 miles. Franklin S. Buell, of Buffalo, N. Y., is interested in the company.

WATERLOO, ONT., CAN.—We are informed that tenders will soon be called for electrical equipment for the proposed municipal electric plant. Contracts for the construction of the power house have been awarded. George Grosz, of Waterloo, is engineer; Fowl S. Kumpf is secretary of light commission.

WOODSTOCK, ONT., CAN.—The operation of the combined waterworks and electric light plant of Woodstock for the year 1909 has resulted in a general profit of $12,765, of which $6,122 was received from the electric light plant and $6,642 from the waterworks system. In addition to the ordinary running expenses, the Commissioners paid a total of $16,412.85 for interest and to provide a sinking fund for the debentures which are outstanding on this plant. This included a year's instalment of the sinking fund on the debentures which will be issued to the extent of $27,500 for the purpose of preparing the plant for receiving and distributing electrical power from Niagara Falls. When the new system is put in operation, a reduction will be made in the price of electricity for incandescent lamps.

AGUASCALIENTES, MEX.—The Chapala Hydro-Electric & Irrigation Company, of Guadalajara, Mex., has entered into a contract with the Government of the State of Aguascalientes for the transmission of electricity to the City of Aguascalientes and the mining districts of this State. The Pemental interests of the City of Mexico, which control the Chapala Hyrdo-Electric & Irrigation Company, have taken over the control of the electric railway system of Aguascalientes and are trying to secure control of the Aguascalientes Light & Power Company. The Chapala company has applied to the Government of Zacatecas for a contract similar to that entered into with the State of Aguascalientes, which will probably be granted. Plans are also being considered for extending the transmission lines to San Luis Potosi. Under the terms of the contract the Chapala Hydro-Electric & Irrigation Company is to furnish electricity to the City of Aguascalientes at a maximum rate of $100, Mexican currency, per hp per year, and in the mining districts at $125 per hp per annum. A minimum of 200 hp must be available within two years. The company now has two power plants on the Santiago River in this State and is completing a third. By the construction of a canal about 17 miles in length the company can develop 90,000 hp, and now that plans for supplying distant cities and mining districts are developing, it is expected that the canal will be built.

MEXICO CITY, MEX.—A special meeting of the stockholders of the Mexican Light & Power Company has been called for Jan. 20 to vote on the proposition to increase the capital stock of the company by $9,000,000.

TAMPICO, MEX.—Carl Heynen, of Tampico, Mex., is reported to be at the head of a syndicate which has been organized to construct and operate an electric railway in Tampico, including an interurban railway to La Barra, where the shops and hospital of the National Railways of Mexico are located. The local system will cover the principal streets and the interurban will be about four miles long. Arrangements are also being made by the syndicate to take over and consolidate the two electric light plants in Tampico.

New Industrial Companies.

THE CANADIAN ELEVATOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and sell elevators and all kinds of hoisting machinery. The incorporators are: William E. D. Stokes, Frederick A. James, of New York, N. Y., and T. Larsonn, of Worcester, Mass.

THE CENTRAL MEXICO LIGHT & POWER COMPANY, of Augusta, Me., has been incorporated with a capital stock of $2,750.000 for the purpose of leasing and using machinery. E. M. Leavitt of Augusta, Me., is president and treasurer.

THE GLASS TELEPHONE MOUTHPIECE COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $70,000 for the purpose of manufacturing mouthpieces and other attachments for telephones. The incorporators are: A. E. Garbe, of New York, N. Y.; C. A. Cole, of Hackensack, N. J., and R. F. Tully, of Jersey City, N. J.

THE HEANEY ELECTRIC SALES COMPANY, of Chicago, Ill., has been chartered by W. S. Lewis, J. Graham and A. Carroll. The company is capitalized at $2,500 and proposes to manufacture and sell electrical goods.

THE HOME ELECTRIC APPLIANCE COMPANY, of Allegany, N. Y., has been incorporated by William B. Ensworth and John Laubenthal, of Allegany, N. Y.; B. E. Border, of Olean, N. Y., and others. The company is capitalized at $20,000.

THE HUDSON VACUUM CLEANER COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 by E. Elmendorf, of Newark, N. J.; A. Hugson and F. F. Bowyer, both of Jersey City, N. J. The company proposes to do a portable vacuum cleaning business.

THE R. G. AUTEN ELECTRICAL COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by R. G. Auten, J. R. Winchester, T. A. Adams and others. The company proposes to do a general electrical contracting business.

THE SELF-PROTECTOR ALARM COMPANY, of New York, N. Y., has been chartered by Gustavus Adolphus Pfizer, of Paris; Edward Wasermann and Frederick F. Leyden, both of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell burglar alarms.

THE YOUNGSTOWN ARMATURE & CONSTRUCTION COMPANY, of Youngstown, Ohio, has filed articles of incorporation with a capital stock of $10,000, the company to do a general engineering business, including power-house construction, rewinding of armatures, refilling of commutators, manufacturing of armature and field coils. The officers are: Byron T. Mottinger, president and general manager; Robert F. Elliott, vice-president, and Paul F. Thayer, secretary and treasurer.

New Incorporations.

BRIDGEPORT, ALA.—The Bridgeport Electric & Railway Company has been organized to construct an electric light and power plant. The proposed plant will be equipped with alternating-current generators and gas-producer engines and will have an output of about 250 hp. It is expected that equipment for the plant will be purchased this month. Proposals for construction and equipment should be addressed to J. P. Scarborough, treasurer and manager.

DECATUR, ARK.—Articles of incorporation have been filed for the Decatur Mutual Telephone Company with a capital stock of $10,000. The incorporators are: H. E. Clark, president; J. N. Oglesby, vice-president; J. Burkhardt, secretary; W. S. McGaugh, treasurer; J. F. Dorsett, R. E. Lee and E. M. Plank.

CORONA, CAL.—The Corona Mutual Telephone & Telegraph Company has been chartered with a capital stock of $25,000. The directors are J. B. Golch, Andrew Lindberg, O. M. Grizzle and E. Bonfroy, of Corona, Cal.

SAN JOSE, CAL.—A company has been incorporated under the name of the San Jose Railroads for the purpose of taking over the First Street Railroad and operating it in connection with the Santa Clara railway and to construct other local lines. The company is capitalized at $5,000,000, and the incorporators are: L. E. Hanchett, president; W. R. Lawson, manager; E. M. Rea, secretary and attorney of the Santa Clara railway, and F. E. Patrick.

LAUREL, DEL.—The Sussex Light & Power Company has been incorporated with a capital stock of $50,000 by W. M. Cooper, J. D. Price and M. Cooper, of Salisbury, Md.

IDAHO FALLS, IDAHO.—The Idaho Falls Electric Railroad Company has been incorporated with a capital stock of $1,000,000 for the purpose of constructing an electric railway, 34 miles in length, in the vicinity of Idaho Falls. E. Beugler, of New York, N. Y., has charge of securing right-of-way and franchises. J. L. Miller is president and A. V. Scott, secretary, both of Idaho Falls, Idaho. H. S. Sewell, of New York, N. Y.; F. S. Cleveland and Ray K. Kramer, of Pittsburgh, Pa., are interested in the enterprise.

CHAMPAIGN, ILL.—Articles of incorporation have been filed for the Terminal Power Company by George M. Mattis, W. H. Carnham and B. E. Gramble, all of Champaign. The company is capitalized at $2,500 and proposes to operate heat, light and power plants.

CHICAGO, ILL.—The Chicago United Railway Company has been incorporated with a capital stock of $100,000 by C. G. Dawes, E. K. Boiset and A. Cooks, of Chicago, Ill. The company proposes to operate street railways.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago, Lake Shore & South Bend Railway Company with a capital stock of $250,000 for the purpose of constructing and operating a street and interurban railway system.

CHICAGO, ILL.—The Chicago, Joliet & St. Louis Electric Railway Company has been incorporated to construct and operate an electric railway from Chicago to East St. Louis. The company is capitalized at $100,000 and the incorporators are: H. A. Fisher, F. E. Fisher and L. D. Fisher, of Aurora, Ill.

FREEPORT, ILL.—Articles of incorporation have been filed for the Commonwealth Electric Company by Charles E. Gregory, Richard Armstrong and C. R. Norwood, all of Chicago, Ill. It is expected to have the plant in operation by spring.

HARDIN, ILL.—The Calhoun Telephone Company has been incorporated with a capital stock of $14,000 by Stephen McDonald, Elizabeth McDonald and John C. McDonald.

LOXA, ILL.—The Loxa Telephone Company has been chartered with a capital stock of $2,500 to do a general telephone and telegraph business. The incorporators are: Fred Behrends, Charles F. Behrends and George E. Shine.

NEW BOSTON, ILL.—The New Boston Electric Light & Power Company has been chartered with a capital stock of $10,000 by Harry A. Bauer, B. Poffenbarger and Frank C. Dixon, all of New Boston, Ill. The company proposes to operate light and power plants.

ROCK ISLAND, ILL.—The City Belt Line of Rock Island has been incorporated with a capital stock of $50,000 for the purpose of constructing a belt railway to extend from a point in First Avenue east to the south city limits in the City of Rock Island. The incorporators are: Frederick C. Denkmann, Otto Huber, Thomas J. Medill, Bernard D. Connelly and Hugh E. Curtis, all of Rock Island, Ill.

SPRINGFIELD, ILL.—The Chicago, Peoria & St. Louis Railroad Company has filed articles of incorporation with a capital stock of $1,000,000. The company proposes to construct and operate a railroad from Pekin to East St. Louis, Ill. The incorporators are: H. L. Child, Howard Boehler and J. J. Fraser, all of Springfield, Ill.

FOLSOMVILLE, IND.—The Folsomville Farmers' Mutual Telephone Company has been incorporated with a capital stock of $1,000. The directors are A. M. Fisher, Robert Perigo, P. D. Gannon, G. L. Wilhaus, J. W. Roberts, Robert Skelton and W. N. Boyd.

INDIANAPOLIS, IND.—The Municipal Light & Power Company has been incorporated with a capital stock of $25,000 for the purpose of generating electricity for distribution for lamps, heat and motors in different cities and towns. The head office will be located in Indianapolis, Ind. The directors are: Ira M. Holmes, Harry Holmes, J. B. Parsons and J. B. Taylor.

KINGMAN, IND.—Articles of incorporation have been filed for the Kingman Telephone Company by C. L. Steinbaugh and J. W. Black. The company is capitalized at $10,000.

KOKOMO, IND.—Articles of incorporation have been filed for the Kokomo Western Traction Company by C. C. McFann, Anderson Johnson, George W. Charles, M. R. Doyson, all of Kokomo, Ind., and O. C. Gard, of Young America. The company is capitalized at $10,000 and proposes to construct an electric railway between Kokomo and Young America.

DES MOINES, IA.—The Railroad Promotion & Construction Company has been incorporated for the purpose of promoting and constructing railroads operated by electricity, gasoline, steam or other motive power. The incorporators are: H. H. Polk, A. P. Chamberlain, Charles H. Philpot, William Moran, O. P. Herrick, A. E. Hollingsworth, John McLennan and A. L. Haas.

LEXINGTON, KY.—Articles of incorporation have been filed for the Siebert-Herndon Electric Company with a capital stock of $10,000 by F. O. Siebert, of Lexington, Ky.; J. W. Thacker, J. P. Herndon and B. M. Herndon, of Georgetown, Ky.

REDWOOD FALLS, MINN.—The Redwood County Long Distance Telephone Company has been incorporated with a capital stock of $10,000 by Andrew Olson, R. A. Maahs, A. Johnson, and others.

SCHOOLCRAFT, MINN.—The Schoolcraft Rural Telephone Company has been organized to construct a telephone system to Bemidji. E. E. Chamberlain is secretary and treasurer.

STILLWATER, MINN.—Articles of incorporation have been filed for the Consumers' Power Company with a capital stock of $10,000,000. The company has purchased the local electric light plant and will make extensive additions and improvements to the system. A new power plant will be built at Apple River, Wis. The company will also operate in the towns of Hudson, White Bear, South Stillwater and North St. Paul.

LOUISVILLE, MISS.—Articles of incorporation have been filed for the Winston County Telephone Company with a capital stock of $10,000 by C. H. Wagner, B. F. Brucker and others.

POLSON, MONT.—The Somers, Polson & Missoula Electric Railway Company has been incorporated for the purpose of constructing an electric railway to Somers.

PAXTON, NEB.—The Paxton & Elsie Telephone Company has been incorporated with a capital stock of $5,000 by D. A. Lawler, J. C. Percy, William Robertson, and others.

ALBANY, N. Y.—Articles of incorporation have been filed for the Hartwick Power Company by L. J. Mayer, C. Bunce, of New York, N. Y., and F. L. Hilton, of Jersey City, N. J. The company is capitalized at $100,000 and proposes to supply electricity for lamps, heat and motors.

ALBANY, N. Y.—Articles of incorporation have been filed for the Floral Park Light, Heat & Power Company with the Secretary of State. The company is capitalized at $10,000 and proposes to operate particularly in Nassau and Suffolk Counties. The directors are: William C. Baker, Charles A. Lockwood, E. B. Lockwood and Charles E. Twombly, of Jamaica, N. Y.; William L. Wood, R. W. Kellogg, of Hollis, and John Ebbers, of Union Course, N. Y.

HIGHLAND FALLS, N. Y.—The Highland Falls Electric Light Company has been chartered by Michael Maxey, of Highland Falls, N. Y.; Joseph M. Walsh, of Cornwall-on-Hudson, N. Y., and George W. Blanchard, Highland Falls, N. Y. The company is capitalized at $5,000, and proposes to furnish electricity for lamps, heat and motors.

NORTH SYRACUSE, N. Y.—Articles of incorporation have been filed for the North Syracuse Light & Power Company with a capital stock of $5,000. The directors are: William J. Conway, Charles R. Ferguson, William C. Franklin, Charles L. Jackson, Andrew Y. Hamilton, George A. Weller and Irving A. Freeman, all of North Syracuse, N. Y.

WINSTON-SALEM, N. C.—The Yadkin River Railway Company has been chartered for the purpose of constructing an electric railway from East Bend to Donnaha, Yadkinsville and Winston-Salem.

GRAND FORKS, N. D.—The Grand Forks & Brenna Rural Telephone Company has been organized to construct rural telephone lines to connect with the Northwestern Telephone Company. Julius Berg, of Brenna Township, is secretary of the company.

MARTIN, N. D.—The Sheridan County Telephone Company has been chartered with a capital stock of $20,000 by A. H. Nikolaus, G. Kalk, Karl Schauer, and others, of Martin, N. D.

NOONAN, N. D.—The Mutual Telephone Company has filed articles of incorporation with a capital stock of $15,000. The incorporators are: M. E. Wilson, of Fessenden, N. D.; Ralph Souder, of Minneapolis, Minn., and others.

RUGBY, N. D.—The Western Telephone Association has filed articles of incorporation with a capital stock of $50,000 by John E. Richey, of Brazill; A. B. Fox, of Brazill, and W. E. Fox, of Rugby, and others.

TOLEDO, OHIO.—The Toledo, Napoleon & Lima Railway Company has been chartered with a capital stock of $100,000 to construct an electric railway from Toledo to Lima, passing through Henry, Defiance, Putnam and Allen counties. The incorporators are: M. M. Dailey, W. D. Bishoff, M. E. Donaldson, N. W. Gillette and T. E. Gillette.

WILMINGTON, OHIO.—The Manufacturers' Power & Light Company has been incorporated with a capital stock of $25,000 by A. I. Bailey and others.

CALUMET, OKLA.—The Calumet Western Telephone Company has been incorporated with a capital stock of $3,000 by J. L. Herbert, P. J. Byers and Robert Crowly, all of Calumet, Okla.

EL RENO, OKLA.—The Utility Gas & Electric Company has been chartered with a capital stock of $1,000,000. The company proposes to furnish electricity to operate the El Reno-Oklahoma City interurban electric railway, now under construction between the two cities. The directors are: H. H. Stephens, W. R. Criley, C. C. McVay, F. W. Vanness and Lydia McBride, of El Reno, Okla.

KOMALTY, OKLA.—The Komalty Telephone Company has been chartered with a capital stock of $2,500 by Louis Fischer, J. W. Hinton, H. H. Williamson and others, all of Komalty.

MUSKOGEE, OKLA.—Articles of incorporation have been filed for the Webbers Falls & Western Railroad Company for the purpose of constructing a railway from Webbers Falls to Warner, thence to McIntosh, Okmulgee, Okfuskee, Lincoln and Pottawatomie counties to Shawnee, 105 miles in length. The company is capitalized at $100,000, and the directors are: A. H. Peyinghaus, of Muskogee, Okla.; J. F. Sparrow, of Porum; J. B. Crouch, O. L. Hayes and Campbell Russell, of Warner.

PONCA, OKLA.—The Bois De Arc Valley Telephone Company has been incorporated with a capital stock of $6,000 by C. G. Crawford, B. F. Coats and H. E. Copeland.

VALLIANT, OKLA.—The Big Ten Telephone Company has been chartered with a capital stock of $5,000 by William J. Moore, F. J. Roberts and P. A. Wilbur.

MARSHFIELD, ORE.—The Union Traction & Terminal Company has been incorporated by J. M. Blake, G. W. Kaufman and R. O. Graves. The company is capitalized at $100,000 and proposes to construct and operate an electric railway in North Bend and Marshfield and also to connect the two cities.

WINDSOR CASTLE (P. O. HAMBURG), PA.—The Windsor Rural Telephone & Telegraph Company has been incorporated with a capital stock of $5,000 by C. M. Rausch, of Hamburg.

DOVESVILLE, S. C.—Articles of incorporation have been filed for the Dovesville Telephone Company by S. E. Carpenter, H. K. Huey, J. J. Puckett and others.

LANCASTER, S. C.—The Lancaster Light & Power Company has been incorporated with a capital stock of $5,000.

ELBRIDGE, TENN.—Articles of incorporation have been filed for the Elbridge Telephone Company by S. E. Carpenter, W. K. Huey, J. J. Puckett, W. A. Doren and L. R. Simpson. The company is capitalized at $10,000.

ELDORADO, TEX.—Articles of incorporation have been filed for the Eldorado Water & Power Company by George E. Webb, Louis L. Farr, C. O. Broome and others. The company is capitalized at $20,000.

FLATCREEK, TENN.—The Flatcreek Telephone Company has been incorporated by J. W. Frost, Ira Stevens, J. J. Hix and others. The company is capitalized at $3,000.

ROANOKE, VA.—The Mill Mountain Incline has been incorporated with a capital stock of $20,000 for the purpose of operating an electric railway. The officers are: A. B. Hammond, president; C. Markley, vice-president, and O. L. Bottomley, secretary and treasurer, all of Roanoke, Va.

CHIPPEWA FALLS, WIS.—The Melville Settlement Telephone Company has been chartered with a capital stock of $3,250 by George W. White, James W. Melville, James Maloney and James Ryan.

Personal.

MR. NELSON HIATT has been appointed superintendent of the municipal electric light plant at Tipton, Ind.

MR. E. O. GOCHICOA has been appointed manager of the Compañía de Fuerza Electrica de Tampico (Tampico Electric Power Company), Tampico, Mexico.

MR. C. V. KERR, chief engineer of the Kerr Turbine Company, Wellsville, N. Y., has resigned his position with that company, the resignation taking effect Jan. 1.

MR. G. H. HALL has recently been transferred from the Boston office of the Sprague Electric Company to the motor and generator department in the general office, New York City.

MR. JOSEPH B. CRANE, formerly manager of the Broadalbin (N. Y.) Electric Light & Power Company, has become commercial engineer with the Great Northern Power Company, Duluth, Minn.

MR. C. S. RENO, for 15 years the chief engineer of the Triumph Electric Company, Cleveland, has become treasurer and manager of the Expanded Metal Engineering Company, New York, N. Y.

MR. EDWIN G. HATCH, formerly with the New York Central Railroad in the electric car and locomotive department, has recently entered the employ of the Western Electric Company, New York, N. Y.

MR. EDWARD DARROW has been appointed superintendent of the Merchants' Heat & Light Company, of Indianapolis, Ind. Mr. Darrow is city electrician of Cincinnati, Ohio, and has arranged to divide his time between the two cities.

DR. AUGUSTO RIGHI, professor of physics at Bologna, will give a course of lectures at Columbia University next year. Prof. Righi has given special attention to wireless telegraphy and is the author of an excellent treatise on the subject.

MR. E. B. RAYMOND, at present general superintendent of the Schenectady Works of the General Electric Company, has accepted the position of second vice-president of the Pittsburg Plate Glass Company, and will enter upon his new duties on Feb. 1.

MR. E. P. MAXWELL, formerly manager of the gas and electric departments of the Lee County Lighting Company and the Dixon Power & Lighting Company, of Dixon, Ill., has been appointed manager of the gas and electric departments of the Eastern Wisconsin Railway & Light Company, with headquarters at Fond du Lac, Wis.

MR. L. H. THULLEN has recently accepted the position of chief engineer to the Triumph Electric Company, Cincinnati. Mr. Thullen, who is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, is well known as an inventor, having been granted more than two score patents.

MR. R. T. GUNN has resigned as vice-president and general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., and of the Wisconsin Electric Railway Company, of Oshkosh, Wis., because of impaired health. The duties of general manager of both companies have been assumed by the president, Mr. Clement C. Smith.

MR. W. J. BEST, for the past three years Chicago sales manager and engineer for the Buckeye Engine Company, has taken a position with the Wheeler Condenser & Engineering Company, Carteret, N. J., with the title of treasurer. Before his connection with the Buckeye Engine Company, Mr. Best was for five years sales engineer with The Green Fuel Economizer Company in its Chicago office, having previously been erecting engineer for E. F. Williams, in which capacity he put in many large steam power stations, such as those of the St. Joseph (Mo.) Railway & Light Company, the Imperial Electric Light Company, of St. Louis, Mo., and the New Orleans Edison Company. For five years previous to this he was eastern engineer, located at New York, for the Buckeye Engine Company. Besides acting as treasurer for the Wheeler Condenser & Engineering Company, Mr. Best will also have charge of part of the sales and engineering work.

MR. ERNEST LUNN, superintendent of storage batteries for the Commonwealth Edison Company, Chicago, has resigned to affiliate himself with the Firestone Tire & Rubber Company in the manufacture of automobile tires at Akron, Ohio. Mr. Lunn graduated from the University of Michigan in electrical engineering in 1899. His first employment was with the Edison Illuminating Company, of Detroit, and in 1902 he went with the Chicago Edison Company, predecessor of the Commonwealth Company, specializing in the company's storage-battery and automobile work, becoming an authority in his chosen field. A farewell dinner was given in honor of Mr. Lunn at the Hamilton Club, Chicago, on Dec. 30, and it was attended by about 80 of his associates. Mr. W. L. Abbott was toastmaster, and speeches were also made by Messrs. J. F. Gilchrist, J. T. Mountain, P. Junkersfeld, D. Macrae, George H. Lukes, R. F. Schuchardt and E. F. Smith. Songs were given by Messrs. W. R. White, H. Jampolis and Harold Wright. Mr. L. A. Ferguson was unable to be present, but sent a letter. On behalf of those present Mr. Junkersfeld presented the guest of the evening with an album of views of Commonwealth stations and substations, with the signatures of the donors on parchment. A pleasant feature of the evening was the presence of Mr. W. P. Lunn, of Greenville, Mich., father of Mr. Ernest Lunn.

Obituary.

MR. SPENCER TRASK, who for more than 20 years was president of the New York Edison Company, was killed in a rear-end collision on the New York Central near Croton, N. Y., on Dec. 31. Mr. Trask was born in Brooklyn in 1844, and was educated at the Brooklyn Polytechnic Institute and Princeton, graduating from the latter in 1866. He immediately entered the banking business, and in 1881 established the firm of Spencer Trask & Co., which now has offices in New York, Philadelphia, Albany, Saratoga and Providence. Mr. Trask was one of the original trustees, and for many years one of the executive committee of the General Electric Company. He took an active interest in educational matters, having been one of the founders of the New York Teachers' College and president of its board of trustees for 15 years. His philanthropies included many gifts to Princeton and the establishment at Saratoga of St. Christina's Home, an undenominational institution for the care of children and the education of girls for domestic work.

MR. HENRY L. SHIPPY.—We regret to report the death of Mr. Henry L. Shippy, which occurred at his home in New York Jan. 2. Some months ago a cancer developed on his cheek, and though slight at first made rapid progress and led to much suffering during the latter months of illness. Mr. Shippy was born in Emilie, Bucks County, Pa., 64 years ago. For the past 35 years he had been connected with the Roebling interests, and was treasurer, manager and director of the John A. Roebling's Sons Company for some years and until the beginning of his illness. Mr. Shippy was a man of charming personality who had an unusually wide circle of friends in this country and abroad, his acquaintance being extended by frequent trips to Europe and several journeys around the world. As a yachtsman and lover of the sea he formed a warm friendship with Lord Charles Beresford and Sir Thomas Lipton. His yacht was present at all important races at home, usually well-filled with electrical men, for the owner never let go of old acquaintances in taking on new ones. He is survived by a widow and two daughters.

Trade Publications.

POWER FROM EXHAUST STEAM.—A new apparatus, known as a regenerator, has erecently been put on the market for absorbing any surplus steam and storing it up to use in the turbine when the exhaust supply ceases. A booklet entitled "Power from Exhaust Steam," published by the American Regenerator Company, Monadnock Block, Chicago, goes into this subject quite fully and shows by calculations how the maximum amount of available energy in exhaust steam can be turned into useful work. There are also diagrams showing the comparison of efficiencies of various combinations of reciprocating engines and steam turbines.

INTERCOMMUNICATING TELEPHONE SYSTEMS.—The Western Electric Company has issued a new bulletin (No. 1105) describing in minute detail its intercommunicating telephone systems. The bulletin contains 40 pages of descriptive matter, showing the different combinations of systems on which the new Western Electric metal intercommunicating telephones may be used. It also contains the wiring diagrams necessary for the installation of these systems. All parts of the insrtuments are described in detail and well illustrated. The bulletin also furnishes information of general value to those who are interested in intercommunicating telephones.

Business Notes.

F. B. BADT & CO., Monadnock Block, Chicago, reports a great increase in orders for Ward Leonard motor-starting apparatus.

THE HESS-BRIGHT MANUFACTURING COMPANY, Philadelphia, will open a Chicago branch at 1800 Michigan Avenue, about Jan. 20, 1910.

THE BRUCE-MACBETH ENGINE COMPANY of Cleveland, builders of two and four-cylinder vertical gas engines, has opened a branch office in Philadelphia at No. 1020 Drexel Building, which will be in charge of Mr. M. E. Jackson, who will give complete information relative to gas engines, producers and complete gas power plants.

THE WARD LEONARD ELECTRIC COMPANY states that its new catalogue is acting as a good selling agency, for it has a greater number of orders on hand and it is now doing a greater volume of business than ever before in the history of the company. A short time ago many new pieces of apparatus were catalogued for which a large demand has developed.

JAMES J. MURRAY & CO., Murray Flint Glass Works, Philadelphia, have made several changes in the location of their representatives. Mr. Rowland, who represented the company in the West, has been transferred to represent it in the East alone, and will be succeeded by Mr. Arthur Harrison, who will cover the States of Ohio, Indiana, Illinois, Missouri, Michigan, Wisconsin, Minnesota and Kentucky.

THE HESS-BRIGHT MANUFACTURING COMPANY, in connection with its very complete exhibits of "Hess-Bright" ball bearings at the Palace and Madison Square Garden Automobile Shows, has an attractive and useful advertising novelty for special distribution to engineer visitors. It is a slide rule, accurate and convenient, and one will be given or sent to every engineer who registers his name with this company at either show.

THE CENTRAL STATION ENGINEERING COMPANY, First National Bank Building, Chicago, is just finishing the building of a modern heating plant at Crawfordsville, Ind. This company designs and builds central-station heating plants, and has also erected plants at Lebanon, Ind., and Canton, Ill. Mr. David T. Wallace is president of the company; Mr. Charles A. Gillham, secretary and general manager, and Mr. Byron T. Gifford is chief engineer.

THE NORTHERN EQUIPMENT COMPANY, of Chicago, which recently absorbed the American Boiler Economy Company, reports that on account of the rapid increase in the sales of the Copes boiler feed regulator and the Copes pump governor, it has been compelled to move to a larger factory building. It has also given up the office in the Old Colony Building, and the factory and main office is now located at 408-418 West Indiana Street, Chicago, Ill., at which address any communications such as requests for catalogs, etc., should be sent, where they will receive prompt attention.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light and Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

CHICAGO ELECTRICAL SHOW, Jan. 15 to 29, 1910. Manager, Homer E. Niesz, 115 Dearborn St., Chicago.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRIC CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1613 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chabbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrabe, Huntingburg, Ind.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Fred. Leslie, Muncie, Ind.

INDIANA ENGINEERING SOCIETY. Secretary, Charles Brossman, Union Trust Building, Indianapolis, Ind. Next meeting, Indianapolis, Jan. 13-15, 1910.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRIC ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine. Next meeting, Lisbon Falls, Maine, Jan. 12, 1910.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

SAN FRANCISCO ELECTRICAL SHOW, Jan. 29 to Feb. 5, 1910. E. M. Scribner, Chairman.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, Jan. 19 and 20, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 28, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

944,258. INDIVIDUAL PROTECTOR; F. B. Cook, Chicago, Ill. App. filed June 10, 1908. For enclosing fuses. A block of insulating material accommodates fusible conductors and carries terminal posts. A pair of lightning arresters are carried by a pair of the posts, and a spring member is carried by the ground terminal post.

944,259. INSULATOR; A. G. Dennler, East Hampton, Conn. App. filed Feb. 23, 1909. For telegraph wires. The usual insulator has a groove for the main line wire, converging slots intersecting the groove for receiving a tie wire.

944,271. CURRENT-TESTING DEVICE; H. H. Morrell, New York, N. Y. App. filed Sept. 22, 1908. A post carrying a conical terminal plug with means independent of the post or handle for detachably clamping a conductor to the post.

944,305. FIRE ALARM; B. C. Andrews, Mabank, Tex. App. filed April 10, 1909. A fire alarm which may be attached to a bell circuit. The circuit includes a push button and a bow-shaped spring which when released will operate the push button. An inflammable cord holds the spring in tension.

944,347. DOUBLE-ENDED RECEPTACLE; H. R. Sarrent and F. C. De Reamer, Schenectady, N. Y. App. filed July 9, 1907. A double-ended receptacle for incandescent lamps comprising a body and cover with semi-tubular projections forming sockets, the body and cover meeting on the plane between the sockets

944,382. THAWING DEVICE FOR FROZEN GROUND; W. T. Ross, Vaucouver, B. C., Can. App. filed Dec. 28, 1908. For thawing frozen ground in the Arctic regions for mining work A metal tube with an anvil cap and pointed end carries an electric heating coil within the tube, together with means for passing a fluid through the tube.

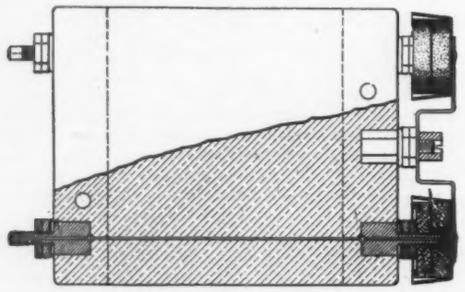
944,397. STERILIZING ATTACHMENT FOR THE MOUTHPIECES OF SPEAKING INSTRUMENTS; W. Williams, Hopkinsville, Ky. App. filed May 10, 1909. May be clamped to the telephone mouthpiece and consists of a tube containing the disinfectant, one end of which is disposed within the mouthpiece and the opposite end projecting therefrom and provided with openings.

944,412. TELEPHONE BOX; W. M. Bruce, Jr., Springfield, O. App. filed April 4, 1907. Wall box for telephone. Includes a hinged lid with openings for the base-fastening devices, and a main telephone box on the lid.

944,453. CONTROL OF ELECTRIC MOTORS; H. A. Mavor, Mile End, Glasgow, Scotland. App. filed Sept. 4, 1909. For starting, stopping and reversing large power motors, particularly for marine propulsion. Uses an exciter, a controller therefor, a controller for the motor and auxiliary motors for driving the controllers with interlocking means to insure that one auxiliary motor alone can be in operation at a time.

944,459. INSTRUMENT FOR LOCATING GROUNDS AND BREAKS IN ELECTRIC CIRCUITS; M. J. Myers, Syracuse, N. Y. App. filed Oct. 13, 1902. For measuring electrical resistance by means of a magnetizable pointer which is subject to magnetic influence and moved automatically to its normal position. The scale shows the position.

944,460. SELECTING APPARATUS FOR TELEPHONE SYSTEMS; C. E. Nichols, Columbus, O. App. filed Dec. 18, 1901. Multiple-circuit telephone system whereby when one instrument is in operation the others are disconnected. Makes use of a continuous current generator, and alternating-current generator, either of which is connectable to the circuit, a signal responsive to alternating-current only, a selector for each local circuit, including a polarized electromagnet and contacts of different local circuits, arranged at different distances from normal position of the armature.



944,258. Individual Protector.

944,495. DRIVE WHEEL; J. E. Osmer, Chicago, Ill. App. filed Aug. 30, 1909. Dispenses with the gear on the axle by transmitting directly from the motor to the car wheel instead of through axle. The car wheel carries a flange to which the gear is secured.

944,496. DRIVE WHEEL; J. E. Osmer, Chicago, Ill. App. filed Aug. 30, 1909. See 944,495. The flange is integral with the wheel and a separately formed gearing is secured to the flange.

944,497. ELECTROMAGNETIC ACCELERATOR; C. O. Pearson, New York, and A. Sundh, Yonkers, N. Y. App. filed Aug. 17, 1908. The power generated by the motor is transmittable at different speeds. Uses a driving shaft, a driven shaft, a plurality of electromagnetic clutches to connect the shafts which are successively energized at periods proportional to their time element.

944,525. ELECTRIC CONTROLLER; W. Walz, Toronto, Ont., Can. App. filed Feb. 10, 1909. Controllers for street car motors to prevent injury to a disabled motor. A plurality of motors, a plurality of circuit breakers each connected to a motor with means for controlling the flow of current to the circuit breakers and means independent of the controlling means for connecting the circuit breakers and motors in parallel.

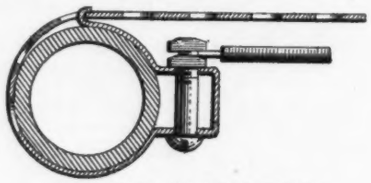
944,540. HEAT COIL; W. L. Coursen, East Orange, N. J. App. filed Jan. 20, 1908. A heat cartridge for use with a protector strip to protect against sneak currents in telephone systems. A non-reversible heat coil carries a reversibly mounted tube which may be reversed after each operation of the heat coil without reversing the coil.

944,545. ELECTRIC SIGNAL; A. F. Dixon, Chicago, Ill. App. filed March 6, 1907. For telephone toll trunks The target consists of two parts hinged together with electromagnetic means to swing the movable part upward and outwardly upon its hinge to display the inner faces of both parts.

944,563. SIGNALING SYSTEM; O. T. Lademan, Milwaukee, Wis. App. filed Feb. 15, 1909. A step-by-step device at the central station operated from the substations with a signal controlling device at each substation and means at the central station for causing the operating devices to start and switching devices at central for causing a selective operation of the signal controlling devices at the substation.

944,575. COMBINED TELEPHONE AND PROTECTIVE ALARM SYSTEM; J. G. Nolen, Chicago, Ill. App. filed Feb. 26, 1906. Makes use of an ordinary telephone line to act as a fire alarm. The ordinary bell and line signal give the alarm.

944,605. ELECTRIC SAFETY BOX; H. A. Fisher, Plainville, Conn.



944,752. Ground-Joint Connection.

App. filed Sept. 30, 1908. An electric safety box for conduits having an opening closed by two shutters, each shutter having a plurality of semicircular cuts so as to provide a smaller opening than the opening in the side of the box.

944,650. ELECTROLYTIC APPARATUS; H. H. Bates and F. Adam, Joliet, Ill. App. filed June 7, 1909. For obtaining chlorates for alkaline earths by electrolysis. The receptacle has moving anodes and cathodes moving in the same direction upon a common vertical axis so as to agitate the solution.

944,665. SELECTIVE ELECTRIC SIGNALING APPARATUS; J. B. Coe, Boston, Mass. App. filed Sept. 25, 1908. A plurality of independent instruments with a single push piece for selectively closing a circuit.

944,667. INCANDESCENT LAMP; C. H. Crutchfield, New Boston, Tex. App. filed Sept. 9, 1908. A hollow body comprising a series of transparent concave sides and a concave end, said sides and end being coated internally with a reflecting medium.

944,699. ORE SEPARATOR; F. T. Snyder, Chicago, Ill. App. filed April 4, 1904. A magnetic ore separator in which a horizontal rotating cylinder carries the material, with means for magnetizing the cylinder and a vertical plate below the cylinder which separates a portion of the falling material and provides a self-renewing inclined deflecting surface.

944,752. GROUND-JOINT CONNECTION; J. C. Vogel, Philadelphia, Pa. App. filed Feb. 6, 1909. A flexible integral band with means at one end for engaging with a portion thereof and means for compressing the band around a suitable conductor.

944,774. ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES; E. F. Cote and P. R. Pierron, Lyons, France. App. filed May 14, 1907. A reducing furnace with a condenser comprising inner and outer casings spaced apart from each other, the outer casing communicating with the furnace and electrodes at each end of the inner casing, movable toward and from each other with a mass of non-fusible material between the electrodes.

944,785. RHEOSTAT; R. Head, New York, N. Y. App. filed Oct. 27, 1908. For steropticians and the like. A light, portable rheostat consisting of a plurality of sections adjustable into compact relationship, the core consisting of a sheet of mica divided into lengths around which the resistance wire is wound. Means controllable by the adjustment of the members cut them into and out of the circuit.

944,822. PROCESS OF TREATING OR IMPREGNATING PLANTE NEGATIVE PLATES; H. Rodman, Pittsburgh, Pa. App. filed March 24, 1906. Saturates the active mass with finely divided barium sulphate which acts as an expander.

944,826. PRODUCTION OF ALLOYS OF ALKALI-EARTH METALS, &c.; G. O. Seward and F. Von Kugelgen, Holcombs Rock, Va. App. filed March 28, 1906. Electrolyzes a mixture of fused compounds and maintains the concentration of the less electro-positive metal so low that the alkaline earth metal is separated jointly with the less electro-positive metal.

944,869. TROLLEY APPARATUS; C. O. Jackson, Fairmont, W. Va. App. filed April 3, 1909. Prevents a trolley wheel from jumping the wire by providing a head through which the pole extends and spring-pressed members with rounded ends, one on either side of the wheel, carrying friction rollers at the free rounded ends.

945,006. MOTOR-CONTROL SYSTEM; P. H. Thomas, Pittsburgh, Pa. App. filed Dec. 4, 1903. For accelerating a direct-current motor supplied with power from an alternating source by a vapor converter which transforms alternating into direct currents.

945,008. MOTOR-CONTROL SYSTEM; P. H. Thomas, Pittsburgh, Pa. App. filed Sept. 4, 1903. See 945,006.

13,060. (Reissue) ELECTRIC TOASTER; W. S. Andrews, Schenectady, N. Y. App. filed Oct. 12, 1909. A plurality of electric heaters vertically arranged with an openwork wire cage enclosing them and two folding baskets to receive the material to be heated at the sides of the units.